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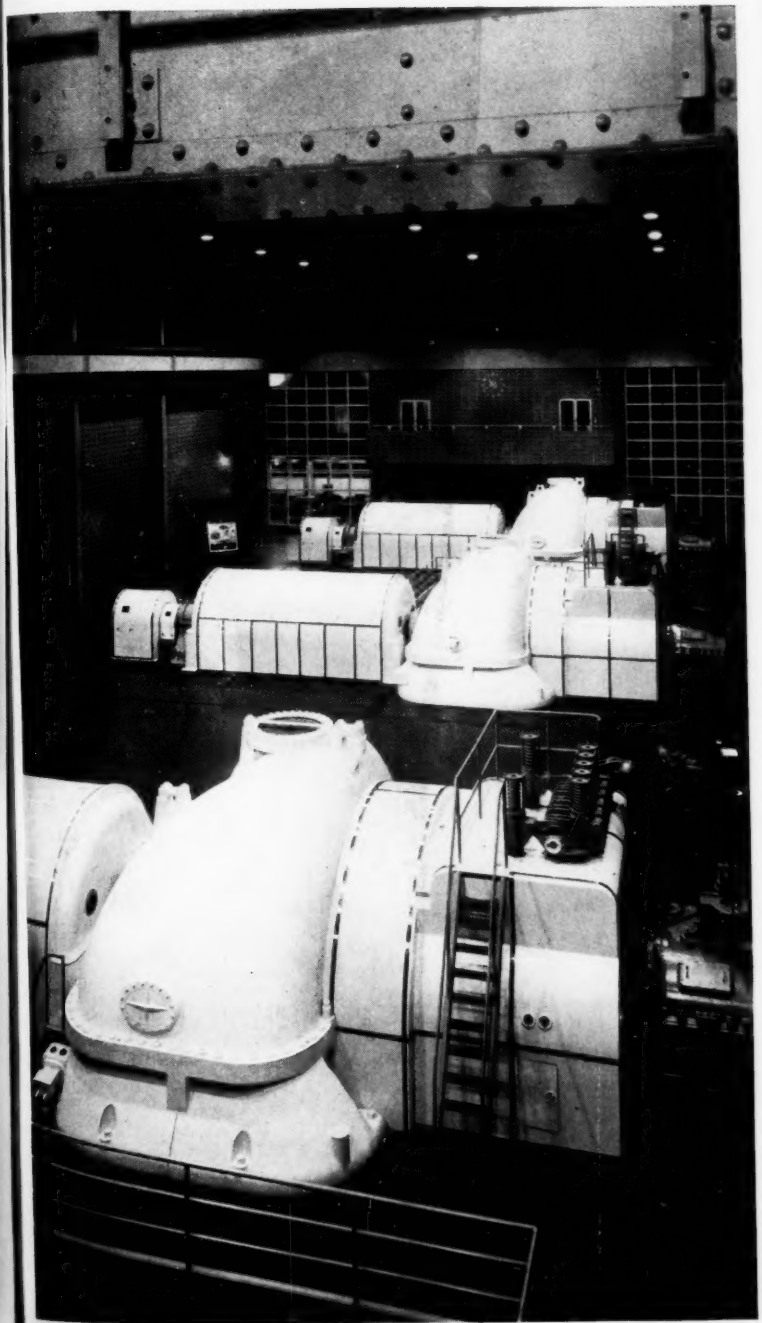
Power Plant ENGINEERING



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COVER: THREE 60,000 KW TURBINE GENERATORS IN WATTS BAR STEAM STATION OF TENNESSEE VALLEY AUTHORITY

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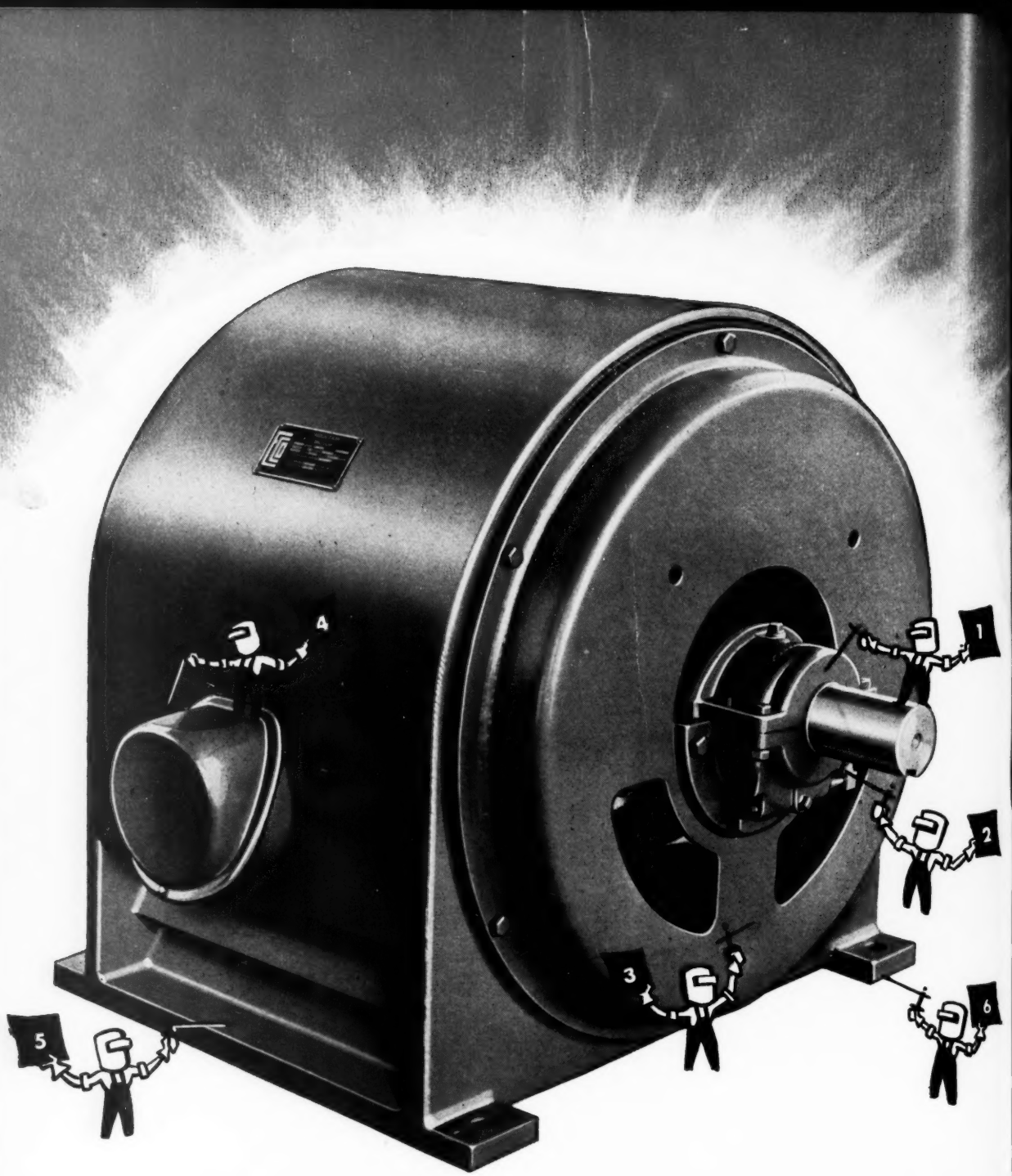
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

AUGUST, 1947



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Power Plant ENGINEERING

August, 1947

VOLUME 51—NUMBER 8

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Editor
ANDREW W. KRAMER
Managing Editor
CHESTER R. EARLE
Associate Editor
THOMAS E. HANSON
News Editor
GEORGE V. TEAL
Associate Editor

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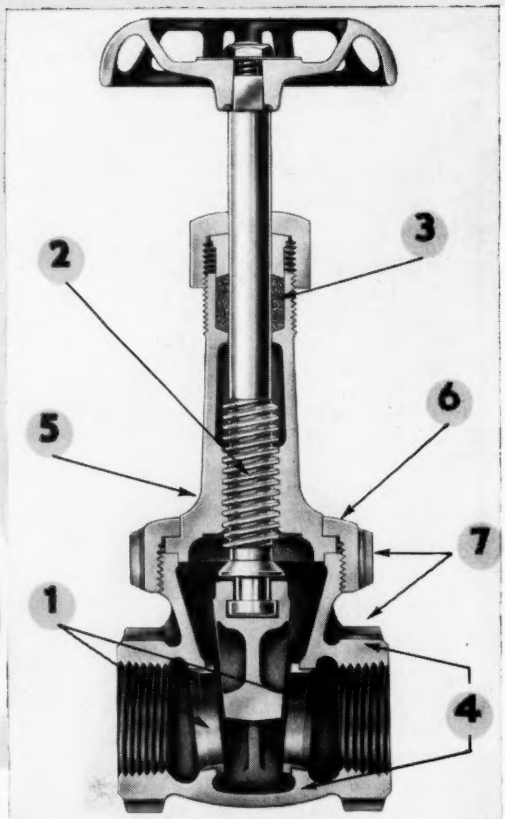
IT'S NEW . . . IT'S FAR AHEAD — IN DESIGN—IN DURABILITY

JENKINS FIG. 270-U BRONZE GATE VALVE



1. "MONEL" SEAT RINGS EXPANDED IN BODY The seat rings, expanded into place in the body, are equivalent to integral faces. The "MONEL" metal used is about 2½ times the hardness of valve body bronze—provides exceptional resistance to erosion and corrosion.

2. LARGE SPINDLE THREADS LAST LONGER The threads on the traveling spindle are exceptionally long and large in diameter, which reduces wear to a minimum and insures easy operation. Spindle metal is hard, tough manganese bronze.

3. DEEP STUFFING BOX—MORE PACKING Deeper than most 200 lb. gate valves, it holds more packing. Keeps stuffing box tight around spindle with less friction, and packing nut can be turned with less effort.

4. LIBERAL BODY DIMENSIONS ADD STRENGTH Made of 35,000 lb. tensile strength cast bronze—has full length of pipe threads and liberal clearance between threaded ends and diaphragm wall. Union assembly reinforces and strengthens body neck.

5. EXCEPTIONALLY RUGGED BONNET Projection on bottom assures snug fit into neck of body. Large diameter Acme threads, with long bearing, assure improved wear resistance. Machined bevel on underside matches beveled shoulder on spindle for back-seating under pressure and protecting spindle threads when valve is wide open.

6. HEAVY BONNET RING Union Bonnet joint withstands exceptionally high hydraulic pressures. Liberal thread engagement assures assembly that can be made tight and kept tight after repeated disassembly.

7. BODY AND BONNET RING LUGS Rugged sturdy lugs of novel design on body ends and bonnet ring permit repeated application of conventional wrenches.

AGAIN JENKINS PRACTICAL ENGINEERING SETS THE STANDARD FOR VALVE ECONOMY

● *IF ANY PART of the seating combination is to eventually need replacement, why not have it the most accessible part—the wedge rather than the seat? It's easier, quicker, cheaper to slip on a new wedge, than to install a new body!*

That's the principle on which Jenkins Engineers designed the new Fig. 270-U Bronze Gate Valve, with a high-quality bronze wedge seating against MONEL seat rings expanded in the body. With this sensible design, the wear affects only the most accessible part—the bronze wedge—which can be replaced by simply slipping it off the stem and slipping on a new one. Prolonged tests, in toughest service, prove it the best seating combination to beat wear, reduce care.

This new, better Fig. 270-U will give you unequalled economy in any service requiring a 200 lb. pressure Bronze Gate, and especially under severe conditions, such as in oil refineries, dye houses, chemical, food, and rubber plants.

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LOOK FOR THIS TRADE JENKINS MARK DIAMOND MARK SINCE Jenkins Bros 1864

JENKINS VALVES

Types, Sizes, Pressures, Metals for Every Need

WRITE FOR THIS FOLDER (Form No. 181-A). It describes the Fig. 270-U and many other popular Jenkins Bronze Gate Valves. Or, ask your Jenkins Distributor.

ENGINEERS' PREVIEW

STAINLESS STEEL gravity roller-conveyor for use in damp and moisture-ridden locations is 14 in. wide, available in 10-ft sections weighing 123 lb with rollers on 4-in. centers. Channels, rollers, roller ends are 18-8 stainless, bearings are stainless pins in bronze bushings, providing lubrication-free installations without rust.

★ ★ ★

IMPROVED line of air-control valves is designed for operations and pressures to 150 psi, features effortless operation because balanced construction produces pressure on both sides of piston. Speedy action results from full pipe size of ports and internal passages to permit unrestricted air flow. Pistons are light, permitting high speed operation and rapid reversal, especially in electrically-operated models.

★ ★ ★

NEW ALKALINE industrial, cadmium-nickel storage battery is said to combine advantages of lead-acid and nickel-iron types, doing work formerly done by both, plus features of its own. Accepts high or low charging rate with no finish rate limitations; has excellent capacity at low electrolyte temperature without danger of damage due to freezing. Designed for marine industries, railway communications, power plants, food processing, radio, radar.

★ ★ ★

TEN NEW HAMMERS with replaceable hard tips and two with extra soft tips all use plastic Nuplaflex. Designed for work on threads, painted polished plated surfaces, or parts that would be marred, scratched or damaged by metal hammer faces. Tips of same size are interchangeable so the hard and extra soft can be used in one hammer. Automatically locked when tips are screwed into head but are easy to detach. Streamlined heads, octagonal hickory handles.

★ ★ ★

NEW NYLON soft-impact hammer does not chip, break, change shape under hard use nor absorb moisture; eliminates possibility of personal injury via rebound. Interlocking head construction prevents replaceable head from loosening in use. Three sizes are available, No. 664 weighing 32 ounces for heavier work on body and fenders, boilers; No. 662 20-ounce for fitting piston pins, gears, bearings; No. 660 10-ounce for more delicate bearing, distributor work.

★ ★ ★

MORE ECONOMICAL, quicker process, to separate resin and turpentine from pine gum, preheats gum to 350 F, sprays it into a flash chamber at top of 20-ft column. About 80 per cent of turpentine is vaporized in flash chamber instantly and vapors piped through condensing tank to storage. Nonvolatile resin flows down column (surrounded by steam at 125 psi) meeting live steam ascending to take out last of turpentine, and fuse rosin. Both start flowing 5 minutes after gum enters column. A still turns out 1 ton of hot liquid resin an hour, uses two-thirds the steam and half the labor—one man manages it and packages resin. Cost of sample continuous still no greater than older batch still.

THREE material-handling trucks weighing 68 lb for 24-by-48-in. platform model with 6-in. wheels, to 130 lb for 36-by-72-in. with 12-in wheels, each have a truck bed of high-tensile aluminum alloy extrusions, sufficiently flexible to support load (2000 to 5000 lb) on all four wheels regardless of rough uneven floors. Aluminum alloy wheels are equipped with thrust and roller bearings, shakeproof king pins, elastic stop nuts and cured-on solid rubber tires.

★ ★ ★

FUME-PROTECTIVE enamel is not only a suitable coating for interior brick, concrete, wood, metal wall surfaces but is also resistant to sulfide fumes (as from soft coals), acids and alkalis; has withstood boiling concentrated hydrochloric, sulfuric, nitric, acetic acids, warm ammonium hydroxide; also 5 hours in baking oven at 450 F, exposure over doughnut fat-melting pan for 6 months, in bread fermenting room for 6 months, without apparent effect except slight discoloration from hydrochloric and nitric fumes.

★ ★ ★

ALSOCO aluminum solder (from Switzerland, now manufactured here) has good metallic and electric properties; resisted shearing after 250-hr salt spray corrosion test although base metal itself broke; will solder aluminum to aluminum without flux or flux substitute. Aluminum wire soldered to copper terminal with weld-resistance of 20 microhms, after salt-spray test, increased in resistance only 8 microhms. In vibration tests of stranded aluminum cable soldered to standard copper lugs, the 0.25-in. cable broke after 44,000 cycles and the 0.375-in. cable after 1,487,000 cycles—but the solder did not break in either case.

★ ★ ★

PROGRESS is made with super-conductors of electricity; there will have to be much more before the best of them replace copper or aluminum wire, both now cheapest, quickest available, most abundant. The nearest step toward a perfect conductor has been the discovery (in 1946) that liquid ammonia solutions of alkali metals (lithium, sodium, potassium) and alkaline earth metals (barium, calcium, strontium) contain electrons trapped in spherical micro-cavities, two occupying each cavity. Ordinarily two electrons are held together with two atomic nuclei in combination; in these solutions electrons hold together without nuclei, producing super-conductivity. After rapid freezing of the metal-ammonia solution it becomes a more efficient conductor at —85 deg C. While much nearer practical use than absolute zero, this still leaves a broad temperature range to be spanned, according to Dr. Richard A. Ogg, Jr., of Stanford University.

★ ★ ★

SMOKELESS fuel is being made from Utah soft coal in a process developed over the past 7-8 years. Finely-divided coal is passed continuously through a heated horizontal retort, vibrated at a controlled intensity, then coal is pressed into "logs" about 2 in. in diameter. The whole process of converting takes 3 minutes.

NO-BOLT electric fixture stud, die-cast aluminum alloy with ⅜-in. pipe thread, tested to 600 psi breaking strength, is furnished without locknuts now.

★ ★ ★

SILVERCOOL asphalt-base aluminum insulator and preservative, can be sprayed or brushed on metal, wood, felt, asbestos, composition or asphalt roofs without priming, reflects 74 per cent of sun's rays, reduces roof expansion and contraction, lengthens life, lowers temperature inside. Applied every 5 years.

★ ★ ★

KRANE-KAR mobile-power, swinging-boom, rubber-tired crane usable inside plants or outdoors, can negotiate outdoor plant and yard roadways. Grades to 15 per cent with full load. Gasoline or Diesel engine provides power for traveling and for crane through wire cables and sheaves to end of tubular boom. Available with electromagnets or clam-shell buckets in 5000, 10,000 and 20,000-lb sizes.

★ ★ ★

GREATER measuring accuracy and half the weight are claimed for a tubular micrometer, especially in the larger sizes. The lighter weight gives greater freedom of movement, lighter touch and feel with little or no drag, all this contributing greatly to accuracy. The instrument includes a wear take-up spindle bushing assembly that compensates for wear. This has three points of contact instead of the usual one; on spindle, at tip and on thread. Upper and lower wear nuts are easily and quickly tightened to re-align the spindle. Tumico threads are ground from the solid to increase precision. Spindle is lapped into barrel for true-fit trouble-free operation. Spindle and anvil are hardened to Rockwell 64C. Hollow frame is of high grade alloy steel with homogeneous grain structure, is electroplated with copper, nickel and chrome to eliminate rust, tarnish-corrosion from perspiration, also possible shock distortion. Available in conventional types from 0 to 24 in.; blade types for narrow depths from 0 to 4½ in., roller mill types with 3 and 6-in. throats; also a complete line of bow types with interchangeable mandrels from 0 to 96 in.

★ ★ ★

A NEW LINE of illuminated meters in 2 and 3-in. sizes with round or rectangular cases, receive light through recessed bulb in back, carried through a lucite cone that entirely surrounds the dial face.

★ ★ ★

STAINLESS steel combustion chamber for commercial and industrial direct-fired heaters increases life, eliminates refractory linings. Eight heaters of same basic design, completely equipped with modern safety devices, range from 400,000 to 2,000,000 Btu per hr.

★ ★ ★

DIAMOND G spring nut with all advantages of a regular nut, resembles a flat coil spring of two turns with inside edges shaped to the thread grooves, is said to have greater gripping power, thus more resistance to loosening. Replaces conventional nut, is a single assembly operation, assures positive locking action, also is adaptable to hopper feeders and use with power wrenches.

THE RECIPROCATING steam locomotive was supreme on the American railroads from the beginning of the railroad industry. Early in this century the electrical engineers predicted that the steam locomotive was on its way out and would be very shortly supplanted by the electric locomotive receiving its power from trolleys, such power being produced either by large coal-burning central stations or, as is the case on our electrified divisions, from water power. While there is considerable mileage at present of electrified railroad operation, this prediction, of course, was not fulfilled. Without question, however, the supremacy of the reciprocating steam locomotive is now seriously challenged by the Diesel-electric. It appears further, however, that even with this new type of motive power, it will not have the same lack of competition as did the steam locomotive. Such competition will not be restricted to the coal-burning gas turbine locomotive. In sections where heavy fuel oil is abundant and relatively cheaper than coal because of transportation costs on the latter, the oil-burning gas turbine must be considered. Neither can we totally discount future possibilities of steam. A geared steam turbine locomotive is now in service on the Pennsylvania Railroad which, though somewhat limited in its application, has opened new avenues of thought. These include variations in the drive which would eliminate side rods, possible use of induced draft to reduce back pressure, possibilities of new boiler designs permitting higher pressures. There is, furthermore, now under construction a coal-burning steam turbine electric locomotive, which so far as its ability to haul cars is concerned, will have the same characteristics as a Diesel-electric of the same horsepower. As in the case of the gas-turbine, it is also true of any steam locomotive that it can burn the cheaper, heavier grades of fuel oil, a luxury as yet denied the Diesel engine—A. G. Hoppe, General Superintendent, Locomotive and Car Depts., Chicago, Milwaukee, St. Paul & Pacific R. R., before Midwest Power Conference, March 31, 1947.

★ ★ ★

INJECTION-MOLDED nylon washers in six sizes, are resistant to abrasion, cold flow, chemicals, changes in temperature; are free from odor or taste, have low moisture absorption, low friction coefficient.

★ ★ ★

NEW ELGILOY metal alloy suitable for jet propulsion, gas engine parts, valves, other units, has these features; 100 per cent rust resistance, ability to function without permanent set; resistant to all ordinary chemicals; in spring form delivers constant effort over long periods, non-magnetic, superior physical properties.

★ ★ ★

DURUNDUM abrasive cement repairs worn stair treads, unlevel floor surfaces. Comes in dry powder, water is added, applied with trowel. Makes a solid bond with slate, marble, concrete, terrazzo or wood, even on a feather edge, giving non-slip effectiveness. Will support walking traffic in 6-8 hr, can be colored to match or contrast.

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS, WALLS

1 Fire Brick Handbook—Plastic fire brick and its many applications are covered in this new 40-page book. The bulletin covers anchors, specifications, installations, applications, specialities, engineering data and a double page tabular spread of condensed information on the company's line of products. The section on applications is the largest and contains drawings, photographs of typical installations and detailed information on performance. The booklet is well illustrated and arranged throughout. Laclede-Christy Clay Products Co.

2 Water Tube Boilers—Steam generating equipment and water tube boilers are described in this 28-page bulletin issued recently. The excellence of the company's design and workmanship are stressed in the opening pages of the booklet and the remainder of the bulletin goes on to show various models and pieces of equipment which are available. Several line drawings of nearly every model are presented along with a brief description. Edge Moor Iron Works, Inc.

3 Automatic Boilers—Here are two bulletins which describe the company's line of automatic boilers from 3½ hp to 200 hp, pressure from 100 to 150 psi. One of the bulletins is completely devoted to a description of a new line—the Model A—which is available in sizes from 3½ to 7½ hp. Each of the bulletins is well illustrated and contains tabular information on specifications, dimensions. Construction of the boilers is well brought out in the many sectional illustrations. Steamaster Automatic Boiler Co.

4 Steam Generators—This four-page bulletin, printed in three colors, presents information on the company's line of inclined water tube automatic package boilers in sizes from 5 to 250 hp. Photos of interior construction and exterior appearance of the units are printed and brief descriptions of the unit's advantages are presented. Economy of first cost and operation are stressed. Mund Boilers, Inc.

5 Tube-Tile Furnace Wall—Bulletin B-547 describes the company's new tube and tile wall designed for application to all draft zones of the boiler. The bulletin presents a complete cut-away section of the installation showing how the design makes possible an enclosure following contour of the tubes, how insulation is held in place by rods placed at predetermined locations, how the waterwall tubes, tiles or block insulation expand and contract independently of the outer coating. The illustrations in the folder are unusually clear and demonstrate clearly the construction and advantages of the wall. Geo. P. Reintjes Co.

COAL HANDLING

6 Magnetic Separation Manual—Bulletin 260, 32 pages, covers this manufacturer's magnetic pulley and pulley-type separators for use in separation of metals and protection of machinery by the removal of tramp iron. A description of the operating principles is followed by a two-page listing of specifications of the unit. Another two pages give "How to Select" information which is accompanied by a large table of selection factors. Tables of capacities, shipping weights, dimensions, etc. and a description of construction details follows this section. Dings Magnetic Separator Co.

7 Car Dumper—Rotary dumpers for mine cars and railroad cars are described in a 20 page Booklet 2048-A. The first section of the booklet describes the principal of operation of the unit and, by means of excellent illustrations and accompanying descriptive matter, shows the advantages and features of its construction. Complete systems of car feeder haulage are illustrated also, and an overall illustration of a car dumping system occupies the center spread of the booklet. Typical installations of the unit are shown. Link-Belt Co.

PUMPS, COMPRESSORS

8 Centrifugal Pumps—There are 8 pages on the company's line of centrifugal pumps from ½ to 2 in. side suction in Bulletin 3900-B. Performance tables for the various models are presented and excellent photographs picture overall and details of construction. Specifications are included. The Deming Co.

9 Air Compressors—Bulletin H-620-B26 is a four page bulletin covering the company's "Air King" compressors. Two tables of capacities and ratings, one for the single stage unit for pressures of 100 to 150 psi and one for the two-stage unit for pressures of 125 to 250 psi, are presented. Specifications and standard equipment are given in list form and another table of weights and dimensions is printed on the last page of the bulletin. Worthington Pump & Machinery Corp.

10 Centrifugal Pumps Bulletins—Bulletins 227 and 236 (both revised) describe three types of single stage, double suction centrifugal pumps. Detailed specifications of the units are given and full-page tables of capacities in gallons per minute at various heads round out the information. Dimensions of the units are shown by means of a full page table which is accompanied by dimensioned drawings. Warren Steam Pump Co., Inc.

11 Pumping Units—Bulletin 726-C is a 12-page catalog which describes the company's line of "Unipumps." Photographs of the pumps are presented and cross-sectional wash drawings show the construction and operation of the units. Two full page selection tables—one for 60 cycle speeds and one for 50 cycle speeds—for cold water and brine are presented. Another full page of engineering information includes dimensional information on pump and motors; tables are supplemented by dimensioned line drawings. Selection tables and more drawings accompany a page of construction features. An unusually useful section is "How is Reduce Pump Costs." This is accompanied by a full page friction table showing friction of water in pipes for various heads. Typical installations are pictured. The Weinman Pump Mfg. Co.

INSTRUMENTS, CONTROLS

12 Time-Cycle Controllers—A new 12-page bulletin, No. C305, has just been issued by this company covering its new line of Model C500 Impulse-Sequence Time Cycle Controllers. The bulletin gives detailed information about the controller for use in general process applications. The booklet is liberally illustrated with line drawings to show principle of operation and method of use on typical plant processes. The Bristol Co.

13 pH Meters and Electrodes—Two bulletins—170 and 86-C—have been issued by this company; the first describes its pH meter and the second pH electrodes and accessory equipment. Bulletin 170 gives a complete and detailed description of the instrument and its operation and presents a price list of replacement parts. Price lists and short descriptions of the electrodes and their uses are given in Bulletin 86-C. National Technical Laboratories.

14 Smoke Indicator—A data sheet, Bulletin 580-C, on this company's recently-developed smoke indicator has just been issued. The instrument, designed primarily for use with oil and stoker-fired equipment, is described briefly in the data sheet and line drawings show electrical hook-up of the unit and also give its dimensions. Ess Instrument Co.

15 Temperature, Pressure Instruments—Catalog 101-H, 52 pages, covers company's complete line of industrial thermometers, hydrometers, recording thermometers and gages, diaphragm motor valves and many similar items. The booklet is carefully arranged with all companion types of instruments de-

POWER PLANT ENGINEERING

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scribed in one section with complete tables of connections, sizes and prices presented in tabular form and with complete general data accompanying. Descriptions of the company's recording thermometer charts give range, graduation and duration of the chart and each chart is identified by number. H. O. Trerice Co.

16 Flowrator Bulletin—Catalog Section 25-E is a new bulletin describing this company's instruments for measuring flow rate of liquids and gases. The literature includes descriptions and illustrations of instruments, both assembled and disassembled. Numerous new accessories are shown, including a horizontal line adaptor which makes it possible to insert flow measuring meters as easily in horizontal runs as they previously could be inserted in vertical pipes. Details of front and rear panel mounting, rear lighting arrangements, steam heating coils, and alarm devices are among the items included. Fischer & Porter Co.

ELECTRICAL

17 Fuse Puller, Circuit Tester—This catalog sheet describes a fuse puller and circuit tester for use by electrical maintenance men. One end of the tool may be used to test open circuits, base receptacles, grounded fixtures and blown fuses. By reversing the tool it becomes a fuse puller. The device is well illustrated. Star Fuse Co.

18 Power Transformers—This Bulletin TU-181 is a collection of several smaller bulletins each of which covers one particular transformer. Besides the complete constructional and rating data given in the bulletins the back portion of the collection presents information of general engineering interest. Wagner Electric Corp.

19 Splices and Tapes—This booklet, OK-1007A—describes, in picture and and text, proved methods and materials that result in perfect splices. Sections such as "What You Should Expect of Rubber Splicing Tape," and "What You Should Expect of Friction Tape," tell the story of products and then the latter section of the booklet "General Instructions for Joining Rubber Insulated Cables Up to 5000 v," shows in step-by-step photos and accompanying description the methods of joining. The Okonite Company.

20 Oil Circuit Breakers—A revised bulletin on the company's oil circuit breakers (Type DZ-40B) has just been issued. This Bulletin 71B6179B describes the construction of the breaker and lists its extra protection features, lists accessories and provides a table of maximum current, voltage and interrupting capacity ratings. A reference chart of general dimensions also is given. Allis-Chalmers Mfg. Co.

21 Power Plant Control—Control and signalling equipment are covered exclusively in this recently-issued 8-page bulletin. The booklet illustrates annunciators in various sizes and styles, audible signals and an automatic paging system. Relays and switches are illustrated also. Still another section of the booklet covers equipment using a print recorder which automatically prints a record in plain English of all station operations from the inception of trouble to the final restoration to normal. The Autocall Co.

POWER TRANSMISSION

22 V-Belt Booklet—This new bulletin, 26 pages, describes features and advantages of the company's line of link V-belt which is adjustable to any length and adaptable to any drive. Construction details of the belt are thoroughly explained and a series of "how-to-do-it" photos show how to couple and uncouple, measure and install the belt. Also included are tables of engineering data and 13 pages of application photos showing installations in a wide variety of industries. Manheim Manufacturing & Belting Co.

23 Flexible Coupling Data—Available now to engineers and other interested officials in the revised edition of this company's flexible couplings catalog. It shows the entire line of the company's couplings from ⅛ to 2500 hp and presents considerable engineering information. "Selector Charts" included with the catalog show instantly the exact coupling for every job along with prices, bores, sizes and other pertinent data. Lovejoy Flexible Coupling Co.

24 Roller Chain Drives—"The Diamond Diesel Drive Dozen," is the title of a new bulletin which covers roller chain engine drives. Included in the booklet are a series of examples of timing, pump, generator, blower, exciter and other auxiliary drives. Installation views and schematic drawings illustrate clearly these engine applications. Diamond Chain Co., Inc.

25 V-Belt Handbook—The 384 pages in Catalog 280 have been arranged with great consideration being given to convenience and simplification of data. The book is divided into six main sections, printed on different colored stock. Information on how to select drives, characteristics and advantages of various types of drives, drive selection tables, engineering data, prices and dimensions, and interchangeability lists are presented. The booklet also tells how to design fixed-center drives, quarter-turn drives, etc. The Dayton Rubber Mfg. Co.

26 Couplings Data Book—Catalog No. 46, 52 pages, is spirally bound in a separate heavy paper cover; it provides complete engineering and catalog information on the company's line of self-aligning couplings. An illustrated index of the available types of couplings is presented in the front part of the booklet. Information on the solving of misalignment problems, on the company's particular design and principle, errors of alignment, principles of lubrication, etc. follow. Complete material and dimension information on each coupling also is included. Bartlett Hayward Div., Koppers Co., Inc.

TREATING

27 Water Softeners—This new Bulletin 5 describes this company's latest type sodium and hydrogen zeolite water softeners and demineralizers. The bulletin concisely outlines the applications, principles of operation, and the equipment used in these methods of water treatment. It is illustrated by flow diagrams and drawings showing the design of the company's equipment. Liquid Conditioning Corp.

28 Fuel Treatments—These two bulletins describe the company's chemical treatments for fuel oil (to prevent sludge formation) and for removing soot from coal, wood or oil-fired combustion systems. The first bulletin describes the action of the sludge removing chemical and tells what it will accomplish for the user. A description of how to use the chemical is given. The second bulletin shows the dollar value of heat wasted with varying thicknesses of soot deposit. Magnus Chemical Co., Inc.

29 Boiler Water Conditioning Booklet—This 12-page booklet defines terms and describes and reviews the objectives in boiler water conditioning. Many questions are asked by the booklet which then proceeds to answer them—questions such as "Is a softened water the ideal boiler water?" A solution to industrial water treating problems is proposed. Union Chemical & Oil Co.

30 Soot Remover, Fuel Oil Treatment—Two bulletins, issued recently, cover fuel oil treatment and procedure and soot removal. An explanation of what takes place when sludge forms is presented and the difference between treated and untreated tanks is explained by description and drawings. Method of use of the compound is given. The bulletin on soot removal shows the difference in boiler tubes when treated and untreated and gives information on loss of efficiency due to soot formation. Alladin Laboratories, Inc.

MAINTENANCE

31 Centralized Lubrication—"Studies in Centralized Lubrication," is the title of this recently-issued 8-page bulletin. Stories of achievements made and money saved in individual installations are presented on each page. A typical heading reads, "Savings of $1910.00 a month from $7500.00 invested . . . " The booklet is well illustrated and examples are clearly outlined. The Farval Corp.

32 Faster Floor Repairs—This bulletin points out how important is the time element in making repairs to rough floors. From the standpoint of safety as well as production it shows how it is profitable to use materials and methods that do not tie up traffic lanes or important working areas. A clear description of how to make such repairs is given in the folder which illustrates methods of application. Stonhard Co.

(*Continued on page 169*)

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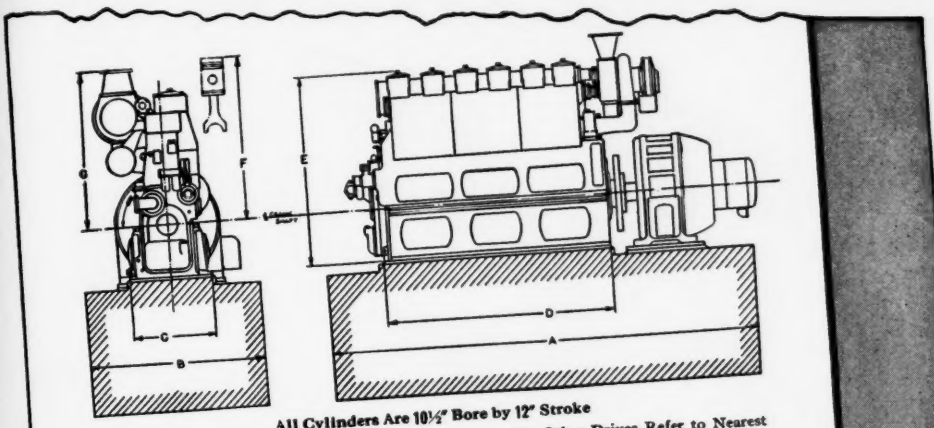

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Dimensions Based on Standard Sixty-Cycle Generator. For Other Drives Refer to Nearest Branch Office.

Type	HP	No. Cyl.	RPM	Dimensions in Feet and Inches						
				A	B	C	D	E	F	G
S	225	3		14-0	7-0	3-4	4-10	7-1	6-3	
S	300	4		14-0	7-0	3-4	7-6	7-1	6-3	
S	375	5	720	14-0	7-0	3-4	8-10	7-1	6-3	
S	450	6	or	18-6	7-0	3-4	10-2	7-1	6-3	
S	525	7	750	18-6	7-0	3-4	11-6	7-1	6-3	
S	600	8		14-0	7-0	3-4	8-10	7-1	6-3	6-0
SS	675	6		18-6	7-0	3-4	10-2	7-1	6-3	6-6
SS	785	7		18-6	7-0	3-4	11-6	7-1	6-3	
SS	900									

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C-E

COMBUSTION

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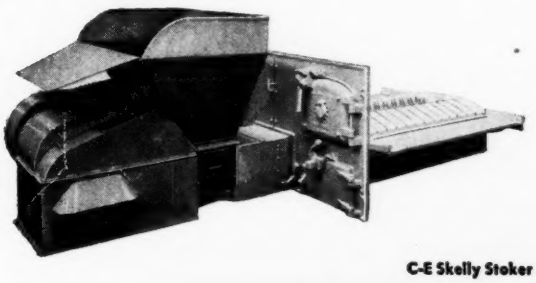

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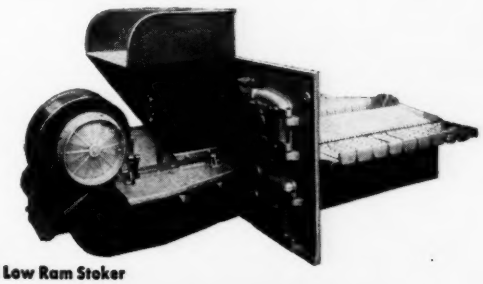

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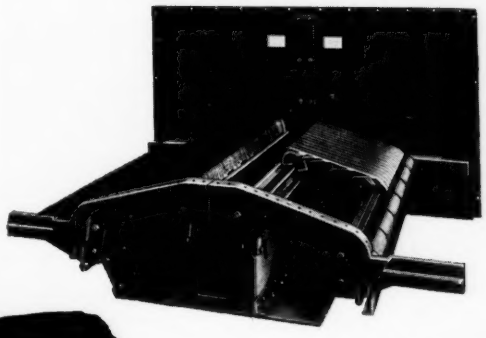
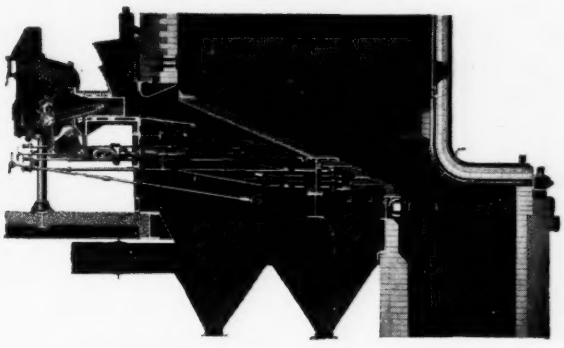
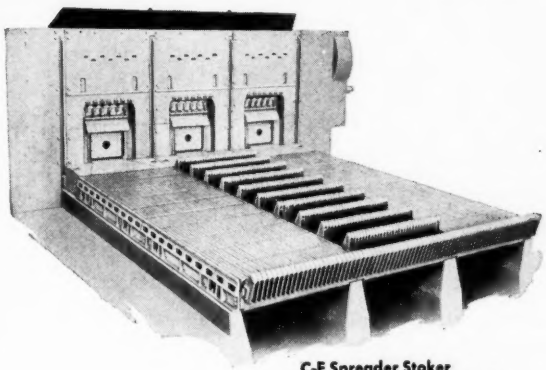


C-E Type E Stoker



C-E Multiple Retort Stoker



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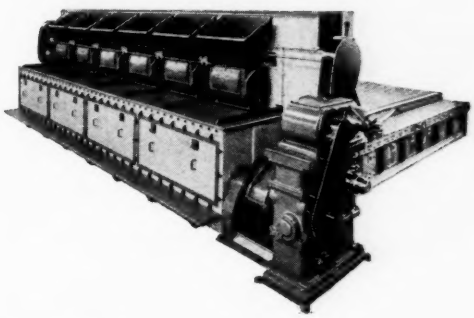
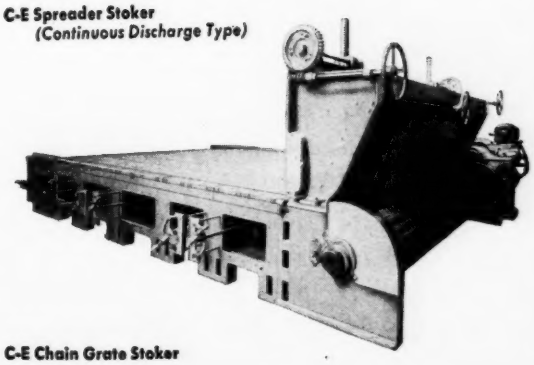


C-E Spreader Stoker
(Continuous Discharge Type)

C-E Traveling Grate Stoker



C-E Chain Grate Stoker

ENGINEERING

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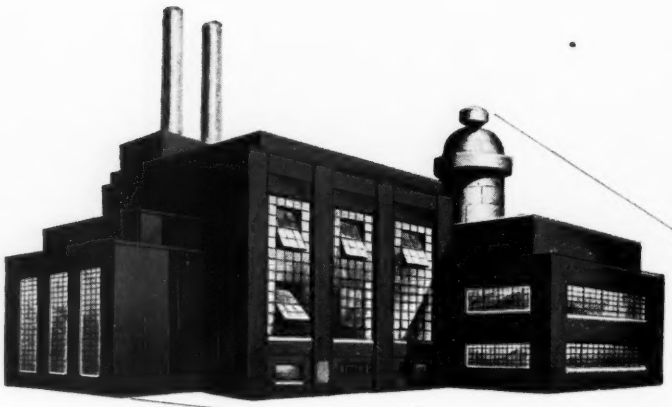

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It's a good rule to follow for some things, but totally inadequate for *efficient* boiler plant operation.

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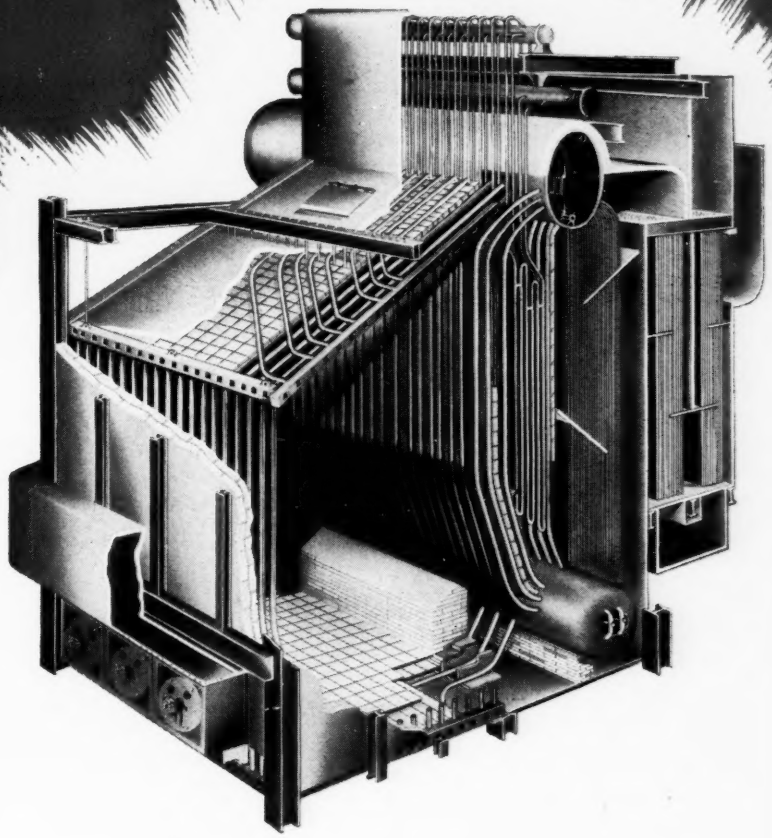

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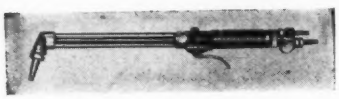
NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

A Cutting Torch With Monel Head

The Airco Series 9000 Cutting Torch with monel metal head and stainless steel tubes, discontinued during the war years because of a shortage of critical materials, is once again back on the market. This torch offers many features. For example, the torch head, made of durable monel metal assures long trouble-free service; the tubes, made of stainless steel offer great rigidity and heat resistance; the stainless steel lever



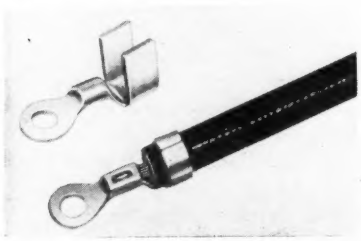
and ribbed handle have been expertly designed to afford maximum ease of operation. Moreover, all connections are silver brazed to assure permanent leak proof service. Air Reduction Sales Co. announces this torch.

A total of 22 interchangeable cutting tips are available for this torch making it adaptable for every practical hand cutting operation from removing rivet heads by washing to cutting sheet metal and trimming plate.

The standard torch is 21 in. long and weighs 3 lb and 4 oz. It is usually supplied with 75 deg. or a 90 deg. head but straight heads are available.

B Small-Wire Terminal

New, one-piece, small-wire Hylug terminals for extra-thick insulated conductors are now available from Burndy Engineering Co., Inc.

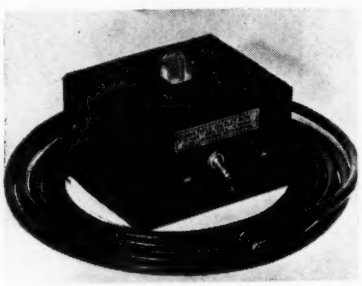


These terminals feature a U-shaped tab designed to accommodate the extra-thick-insulation of conductors frequently used in the leads for switchboard wiring, radio transmitters, video, and other types of electrical and electronic equipment. The tabs grip a wide range of insulation sizes and prevent fraying of the insulation as well as breakage of conductor strands under extreme vibration.

The connectors are indented onto conductors by means of a simple Hytool or Hypress, and the longitudinal indent thus formed actually coins the metal into a solid mass, thereby providing a permanent, low-resistance connection.

C New Outlet Box

Allied Laboratory, Inc.'s Outlet Box, Model 3001-A, is said to solve the problem of coping with an insufficient number of wall outlets. A small unit containing eight standard receptacles, the Multi-Plug can be plugged into any convenient wall out-



let, a-c or d-c, 110-125 v. It is designed for widespread application wherever electric current is used, including laboratories, schools, workshops, factories, hospitals.

The Multi-Plug is useful both where an electrical circuit is needed temporarily, as in the case of temporary lighting fixtures, and where a permanent circuit is needed to enable a large number of instruments or machines to operate from a small number of wall outlets, omitting the necessity for constructing such outlets.

In addition, the boxes can be "pyramided": one can be plugged into another. Two fuses protect the main line against shorts and overloads.

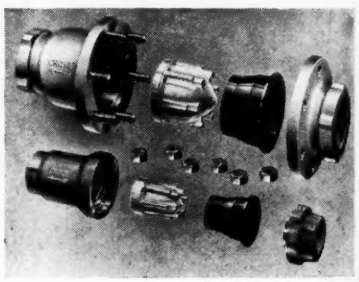
Among the features of the Multi-Plug are: eight standard receptacles conveniently spaced; neon pilot light ($\frac{1}{25}$ watt) tells a-c from d-c, and signals "voltage on all plugs"; long stroke toggle switch breaks both legs of the line; comes complete with 15 amp fuses, 12 ft of heavy duty rubber appliance cord, and unbreakable flat plug; convenient fuse-extractor posts for ready replacement; rubber mounting feet; completely metal-enclosed; all components are underwriters approved. Cabinet dimensions are 3 in. x 4 in. x 5 in.

D Check Valve

Major advancements in the design of Grove Regulator Co.'s Chexflo Valves contribute to vastly improved operating characteristics. The manufacturer states that the valves have no metallic operating parts to stick, slam, chatter or leak, this simplified line of check valves operates on low pressure differential. They are available in sizes ranging from ½ in. to 12 in.

One of the outstanding features of the Chexflo valve is its tough flexible tubular operating member, comprised of a thick load section, tapering down to a sensitive operating lip, which requires no differential pressure to effect positive bubble-tight shut-off. This tapered synthetic rubber lip freely expands to open, permitting unrestricted streamline flow. Due to its resilient elasticity it smoothly contracts to close on slack flow—prior to the start of back flow.

The degree to which it opens or closes is in direct ratio to flow volume. In the open and closed position it is fully supported against pressure or intensive impulse shocks by the inner walls of the



valve body, and the cylindrical acorn-shaped core which it tightly encompasses. As it reaches shut-off position, flow velocity increases to flush the seating surface of any small particles. The resiliency of the flexible tube completely absorbs any and all shock impulses.

E Electrode Holder

The electrode holder is a new addition to the line of insulated tong type electrode holders produced by Tweco Products Co. It is a smaller companion to the A-14 and

AUGUST, 1947

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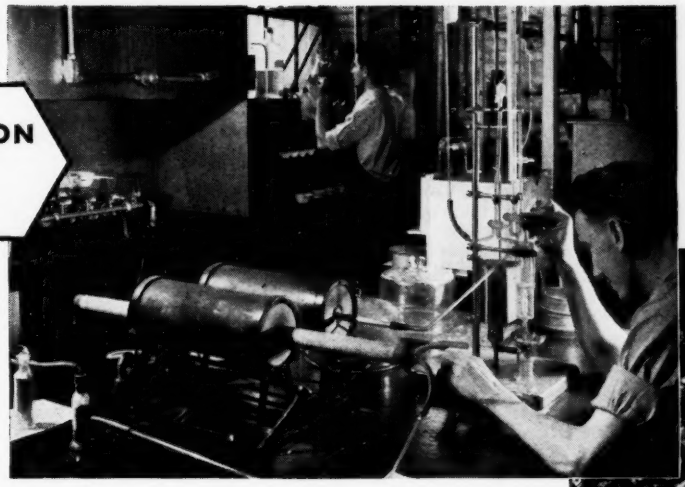

TO FINAL ASSEMBLY

Fig. 2125
Bronze Gate

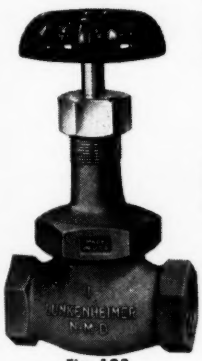

Fig. 123
"N-M-D" Globe
(Non-Metallic Disc)

Fig. 1430
Iron
Body Gate

Reliable Service, Long Life, Low Maintenance Cost *are built into*

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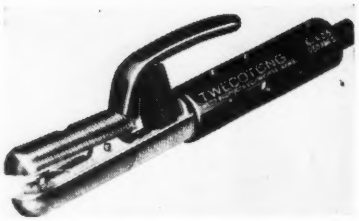


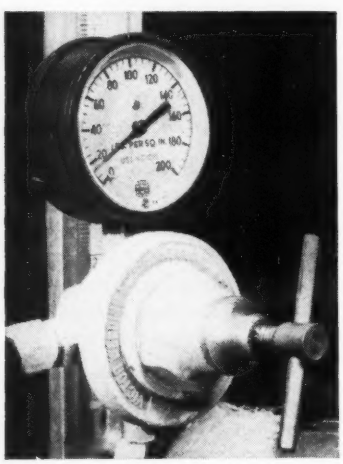
A-38 Holders which have been on the market for some time. Its development fills the requirements of the average job shop or maintenance welder using 200 amp welding equipment.

The A-316 features light weight, compactness, and ease of operation with a 95 lb bite on a 5/16 in. electrode. The tip and body insulation is molded laminated glass cloth bakelite. The insulated spring is Neoprene covered. The cable connection is a simple clamp, plus socket for soldering when desired.

General specifications are: capacity 1 1/16 in. through 5/16 in. electrodes; 250 amp.; weight 9 in.; palm span 2 3/4 in.

F CO_2 Regulator Because carbon dioxide gas is highly refrigerant and freezes so easily, a pressure regulator which can handle it successfully is real news.

Victor Equipment Co.'s Model C10 Regulator has what it takes. Designed with an internal nozzle mechanism which auto-



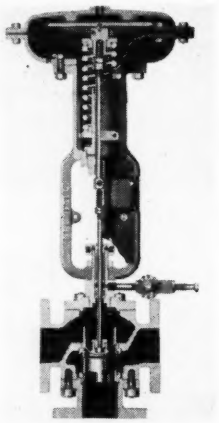
matically removes any dry ice formation from the seat, this regulator is so well adapted to the vagaries of CO_2 gas that dry ice is eliminated from working parts immediately it forms.

Inlet of the model C10 Regulator has also been carefully designed to avoid formation and retention of any dry ice.

G Three-Way Control Valve H. Belfield Co.'s air-operated three-way control valves are specified either for mixing or diverting service. When used for diverting service, the fluid is divided into partial flows of varying ratios as dictated by the signal air pressure. The capacity in each branch line can be regulated between 0 and 100 per cent flow by means of the Type C disc. When used for mixing service, two different fluids are proportioned in varying degrees. In both cases the control disc provides tight shut-off in either end position.

The air-operated three-way valve with mid-position shut-off is specified for intermittent service. This special valve controls the flow of one fluid in the first part of the signal air pressure range, and the flow of another fluid in the remaining part. Mixing of the two fluids is avoided by mid-position shut-off. Small capacity three-way valves are recommended for time-cycle control.

The specified pressure drop remains con-



stant across the three-way valve body regardless of the position of the controlling disc. A group of valve plugs with various flow-lift characteristics is available to meet diversified process requirements. Body and trim are furnished in either the standard metals or special alloys. Composition discs for on-off service are supplied on specification.

The relation between the diaphragm air pressure and the static pressure in the control valve governs the required effective area of the diaphragm motor. Belfield has available a series of diaphragm motor tops with various effective areas which provide ample power to overcome the stem thrust of the valve.

H Electric F.W. Control A new method of sensitively controlling feedwater for boilers, embodying powerful and positive magnetic action, has been developed by J. A. Campbell Co. The product, known as the Micro-Netic electric controller, weighs only 7½ lb and can be attached to a boiler to occupy a space of 3½ in by 7½ in. for its housing

and with a switch box measuring 2 in. by 4 in. by 6½ in. The Micro-Netic embodies a round ball float of monel, capable of resisting a pressure of 400 psi. This float carries a steel ring which attracts the magnets when the ring comes into their fields. Alnico permanent magnets are used, capable of lifting 100 times their own weight. A Micro-switch is used. When the level of water in the boiler lowers to a predetermined point, the magnetic action opens the water line, and when the level rises to a certain point, the feed line closes automatically.

J Dust Collector Designed especially for collecting dust, lint, and dirt from heavy duty polishing, grinding, and buffing work in those states where outside exhaust is mandatory, Model 11N50 Dustkop has been added to its line of industrial dust collectors by Aget-Detroit Co.

Instead of a second stage filter of spun glass and a hand shaker-crank, the cyclone separator is provided with a stack connecting sleeve so that piping can easily be installed to convey the cleaned air out-of-doors. This design is to permit approval of unit type installations in the several states requiring outside exhaust and prohibiting recirculation of cleaned air.

Powered by 1½ hp continuous duty motor, direct driving paddle wheel, self-clearing fan, the unit develops in excess of 1500 cfm at 3.2 in. static suction on a 6½ in. diameter inlet, according to instrument tests. Thus, the unit is claimed to be capable of handling heavy duty loads of shavings and chips from woodworking and from metalworking, and lint and dust from polishing and grinding operations.

Removal of the collected dust is by means of a dust drawer in the base of the collector and other than the occasional removal of the collected dust, no other maintenance is required.

Floor space for installation is 20 in. by 36 in., while the overall height to the top of the cyclone is 35 in. With such limited space required, the unit can usually be placed immediately behind the polishing lathe or the grinder it is to serve.

Installation can further be simplified by using flexible metal hose which makes a slip-fit with the inlet sleeve connection at the dust collector, thereby eliminating that much sheet metal work from the installation.

K Vacuum Cleaner A new and improved model of the Tornado Portable Industrial Vacuum Cleaner is now in production which combines two valuable maintenance aids in one machine without sacrificing the efficiency and practicability of either. It is made by Breuer Electric Manufacturing Co.

By a quick and simple adjustment of two parts readily accessible at the top of the machine, the motor-fan unit of the vacuum cleaner is easily removed and becomes a powerful portable blower which fits the hand naturally and may be directed in any position. A blast of clean, dry air moving at the rate of 295 miles per hour safely removes dust, dirt and sticky fuzz from motors, generators, shafting and similar equipment with difficult, hard-to-reach places where dirt and dust accumulate to cause friction and fire-hazard. It keeps stock shelves and bins dry and clean, removes trash and debris from under machines, and has countless other uses in keeping plants and machinery clean, orderly and safe.

Returned to position on the vacuum

One Order to CRANE covers all the Piping Materials

... And that goes whether you're installing a boiler or a compressor, a process piping system or a washdown water line. You can get everything from Crane.

It's the *complete* Crane line that saves time in writing specifications ... in ordering materials ... and on the installation. It's the line that simplifies piping procedures from design to erection to maintenance. Because it permits standardization on the widest scale ... and because standardizing on Crane equipment gives you this 3-way advantage:

ONE SOURCE OF SUPPLY offering the world's most complete selection of valves, fittings, pipe, accessories and fabricated piping for all power, process, and general applications.

ONE RESPONSIBILITY for piping materials—helps you to get the best installation and to avoid needless delays on jobs.

OUTSTANDING QUALITY in every item—assures uniformly dependable performance from every part of piping systems.

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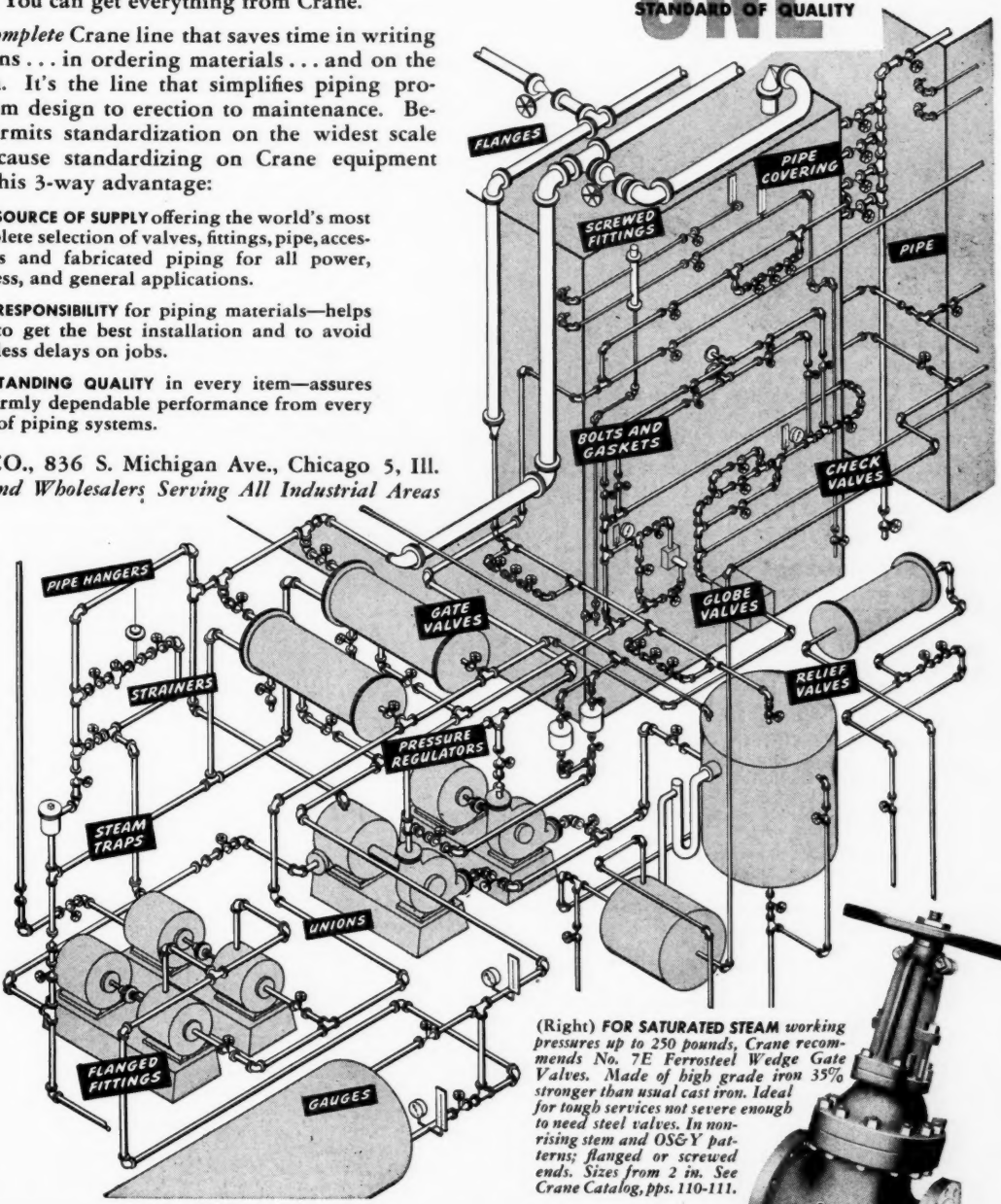
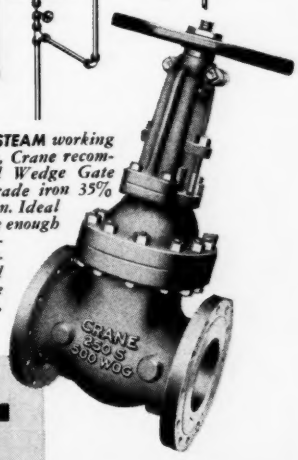


Fuel, water and condensate piping to oil-burning boilers.



(Right) **FOR SATURATED STEAM** *working pressures up to 250 pounds, Crane recommends No. 7E Ferrosteel Wedge Gate Valves. Made of high grade iron 35% stronger than usual cast iron. Ideal for tough services not severe enough to need steel valves. In non-rising stem and OS&Y patterns; flanged or screwed ends. Sizes from 2 in. See Crane Catalog, pps. 110-111.*

EVERYTHING FROM ...

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

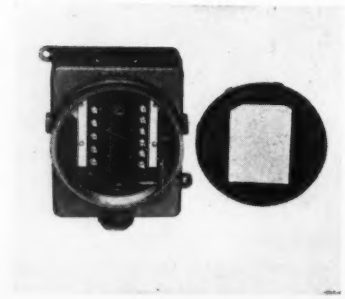
cleaner and locked securely into place just as quickly and simply, the Tornado Portable Industrial Vacuum Cleaner is instantly available for suction cleaning anywhere in the plant,—on tops of boilers, tanks, stock piles, air ducts, on overhead pipes, on posts, on benches and floors,—wherever suction cleaning is needed. The Breuer design of exhausting the air through a bag outside the tank keeps the suction uniformly high at all times. Lighter dust only goes into the bag, and all heavy dirt, scraps and metal particles move directly into the 12-gallon steel tank, bypassing the powerful suction fan so there is no danger of injury or breakage to moving parts. Tremendous cleaning power—185 cfm with a 49 in. waterlift—is secured through a specially designed fan and 1 hp motor.

Level Control Photoswitch Inc. announces the availability of a new Level Control, Type 10CB1X. It has been designed for general application with particular consideration to the problems of the chemical processing field. Ease of installation and maintenance-free performance are featured.

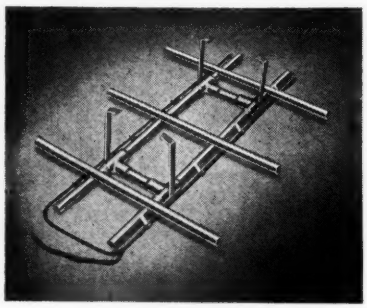
With the principle of this company's design, contact with the liquid is made only by stainless steel probe rods—no floats or other moving parts are required in the tank. No vacuum tubes are used. Accuracy is independent of temperature and pressure.

This level control is an alternating current control that combines a probe circuit and transformer in a unique manner to operate a direct current relay, insuring heavy contact pressures and long-relay life. Two probe rods wired to the control project into the tank to the levels corresponding to the low point where pumping is to start, and the high point at which pumping stops. When the level of liquid falls below the lower probe, the level control closes the electrical circuit controlling the pump or valve. When the liquid rises to the level of the upper probe, the fluid acts as conductor of the minute current at low voltage required for the operation of the relay. Opening of the electrical circuit results, and pumping operations stop.

Level Control Type 10CB1X is designed for installation not only under normal industrial conditions but also under some of the most exacting conditions encountered in the chemical processing field. It is supplied as shown in an explosion-proof housing, or more generally in a pressed steel, dust-tight enclosure.



Boiler Scale Remover Recently put on the market to correct scale, pitting, corrosion, priming and carry-over, etc., in boilers, preheaters and split condensers is a product called NoKeM. It is not a galvanic cell or cathodic type treatment. It operates by collecting and grounding out the existing electrical energy in the water. Once installed, no other treatment or replacement of parts is necessary it is pointed out. NoKeM is put out as a service and is leased to the user. One of the major insurance companies backs it. NoKeM has been tested and proven in major installations for approximately four years. It is adaptable to any size boiler, and is especially adaptable to high pressures. This product is being manufactured by NoKeM Engineering Co., Inc.

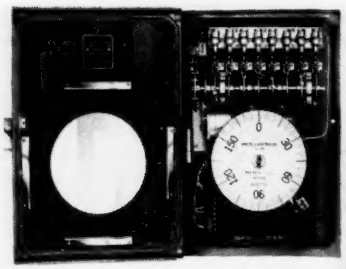


Time Cycle Controller The Bristol Co. announces the development of a new multiple-cam time cycle controller, known as the Model C500 Impulse-Sequence Cycle Controller, for timing mechanical operations in industrial processes. This instrument is designed for use on plant processes where a number of factors, such as the opening and closing of valves, switches, dampers, retorts and presses, and the starting, stopping, or reversing of motor-driven pumps, and blowers, must be accurately timed according to a fixed program. In operation, the Model C500 actuates or engages, at exactly the correct time in each cycle, the necessary mechanical, electrical, or pneumatic devices for automatically carrying out the intended schedule.

In this controller, time measurement and pilot valve operation are handled by separate mechanisms. Separation of these two basic functions made possible a design that gives accurate timing of the factors under control, high speed and torque for pilot valve operation, and flexibility of application.

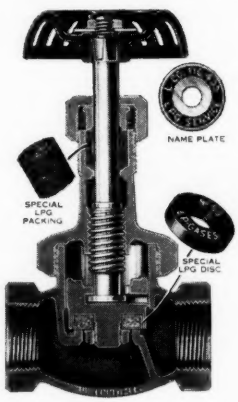
Timing is accomplished by a Telechron-driven aluminum disc on which is printed a 25-in. time scale. The desired schedule of operations is incorporated into the controller by cutting notches with a notching punch on the time scale. The location of these notches determines the time of operation of the cam mechanism. Discs for new cycles or schedules of operation can be easily made. There are no air or mechanical connections between the timing disc and oam-operating mechanism. Time impulses are transmitted electrically.

The cams are individually adjustable and their setting does not require fine adjustment in order to get accurate results. Any sequence of operation can be obtained.



400 Lb Pressure Valve Designed for high pressure liquefied petroleum gas service, the new "N-M-D" (Non-Metallic Disc) Bronze Valve is announced by The Lunkenheimer Co. Made in globe, angle and check patterns, sizes ¼ in. to 3 in., screw ends.

The valve is ruggedly constructed to safely withstand pressures up to 400 lb. w.o.g. Disc and stemp caking are especially compounded for ifg service. Recommended for use on liquefied petroleum gas systems, bulk transfer and storage tanks, domestic cylinder charging manifolds, vapor differential compressors and general industrial uses.



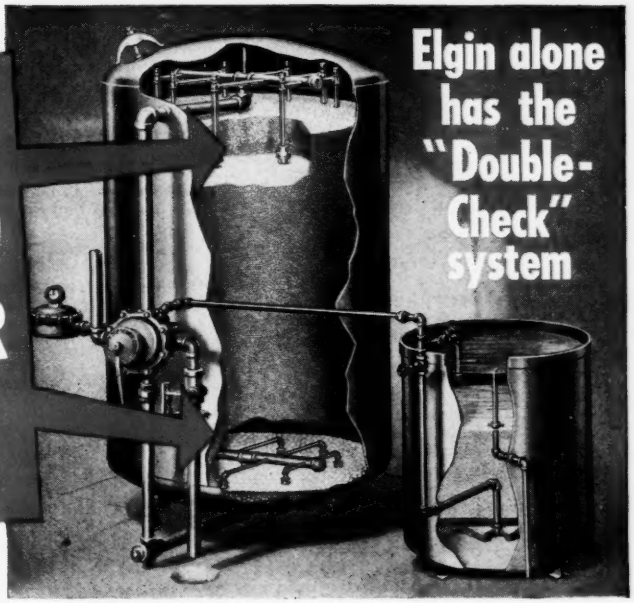
A back seat above the stem thread permits repacking the valve under pressure when wide open. Disc can be renewed with a minimum of time and trouble. All other parts of the valve are also renewable, if necessary.

Conforms to all requirements covering the use of high-pressure liquefied petroleum gases.

New Y-Type Strainer A new, streamlined Y-Type Strainer for steam, air, gas, oil or water is announced by Wright-Austin Co. It is claimed that this improved strainer largely overcomes back pressure through a new

One basic change has

REVOLUTIONIZED ZEOLITE WATER SOFTENING



Elgin alone has the "Double-Check" system

Here's what the new Elgin means to you-

Most plants need more soft water—

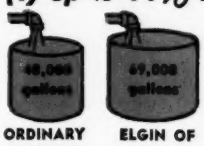
Too often the use of soft water begins and ends in the boiler room. But the extra amount of soft water that costs so little more in the big-output Elgin "Double-Check" Softener permits many uses of soft water that are highly profitable through cutting labor costs, improving processes and reducing maintenance costs. Throughout the hot water system, zero-soft water eliminates scale and lime deposits in tanks, heaters and piping, cutting plumbing costs. In all plant cleaning operations it does a better, faster job with a big saving of soap and cleaning compounds. In many plant processes Elgin "zero-soft" water improves the quality of finished products and where jacketed equipment is involved it increases operating efficiency and cuts maintenance cost.

Where corrosion is a problem, Elgin anti-corrosion treatment gives complete protection.

Your present softener, regardless of make, can be modernized by Elgin to incorporate the features and advantages of the Elgin "Double-Check" Softener. The new bulletin explains this.

When we say the Elgin "Double-Check"* method has revolutionized the zeolite water softener, we simply state a fact that is confirmed by more than 3,000 of these softeners now in service. Users acclaim it; operating records confirm it! Here briefly is what the "Double-Check" Softener means to you:

(1) Up to 44% more soft water: By preventing escape of zeolite, the "Double-Check" manifold system permits utilizing a zeolite bed far deeper in proportion to the size of the softener. Likewise, by preventing escape of zeolite, a higher back-washing rate is made possible. The zeolite is kept clean and active, thus more zero-soft water is produced per pound of salt. For example, a 48″ x 72″ Elgin, softening ten-grain water, delivered 21,000 gallons more soft water per regeneration than a conventional softener of identical size.



ORDINARY SOFTENER — ELGIN OF SAME SIZE

(2) Costs less*—to buy, operate, maintain.* Based on gallons delivered the initial cost of the Elgin is lower. The "Double-Check" distributing and collecting system means less regenerating salt and wash water. Elgin quality means longer life; lower maintenance.

(3) Requires less space. The diagram tells it. This is often a vital consideration.

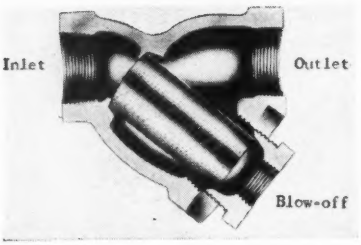
ELGIN SOFTENER — ORDINARY SOFTENER

New bulletin *tells the convincing "Double-Check" story.* State whether you want the general power plant, laundry or hospital edition.

ELGIN SOFTENER CORPORATION

136 NORTH GROVE AVE., ELGIN, ILLINOIS

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING



arrangement of interior surfaces, guiding liquids or gases on a course unobstructed by sharp corners or abrupt changes in path of flow.

The manufacturer states that strainers are self-cleaning by opening of blow-off cock, which flushes grit and dirt out of strainer by line pressure, without shutting off the line or removing the strainer elements.

It is claimed that the use of any one of several types of strainer elements regularly furnished with the strainer body, will prevent fine particles of dirt and scale from passing into steam traps, pressure reducing valves and other sensitive line equipment.

It is stated the free hole area of the screen element in the strainer body is from 2 to 4 times the area of the pipe connection, depending upon service for which the strainer is used and size of strainer.

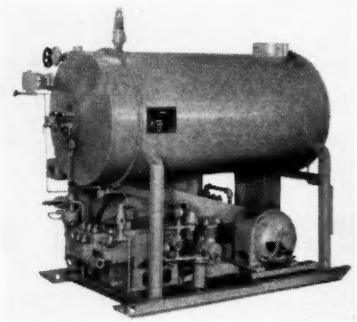
The announcement states these strainers are suitable for use on working steam pressures up to 250 psi and temperatures up to 450 F. For use on cold liquid lines or gas lines the pressure rating is stated as 400 psi.

Q Compact Cooling Tower The Marley Co., Inc. is offering the new Aquatower to the air conditioning and refrigeration field as an answer to the demand for a compact cooling tower of modern design with a high performance rating. Completely assembled at the factory, the Aquatower is sent out as a "packaged product" ready for operation. Features of the unit are: Designed with standard components, no special pumps or motors to return to the manufacturer for service; engineered for indoor or outdoor service; heavy steel integral welded case painted aluminum; sized from 3 tons to 15 tons of refrigeration; available with or without pumps; all component parts readily accessible for servicing; field tested for several years; sturdy fan guard insures safe operation; complete operation and maintenance instructions furnished; designed for air conditioning and refrigeration.

R Automatic Steam Generators Besler Corp. is now in production on a line of package-type automatic steam generators for industrial use.

The generators, of the water tube type, are said to represent the end result of many years of activity devoted exclusively to the modernization of steam generating equipment, and a background of engineering and manufacturing know-how.

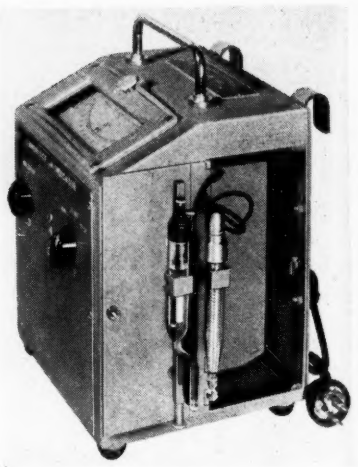
Incorporating a number of exclusive features, the Besler Automatic Steam Gen-



erators are now available in 38, 50 and 75 hp. A 25 hp unit and a 100 hp unit are being added to the line. Among the claims made for the generators are the following: Full steam capacity in 3 minutes or less from a stone cold start; instant shut down; automatic response to load fluctuations; push button starting and stopping; outstanding safety features, no explosion possible; simple installation; new ease of maintenance; high operating efficiency and economy.

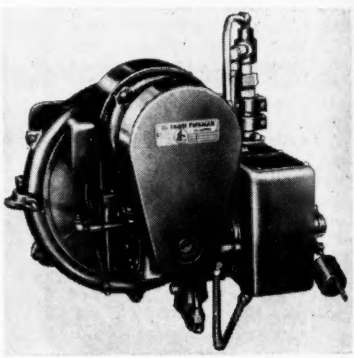
S Direct-Reading pH Meter Unique design, and rugged construction are features of the new industrial model direct-reading pH Meter, for measuring acidity and alkalinity, announced by Cambridge Instrument Co. As a laboratory instrument, it can be used at a bench or table for tests of small samples. As a portable instrument for making spot-checks, its weight of only 10 lb and the mounting of the electrode system as an integral part of the meter, make it convenient to carry. And as a continuous indicator directly on processing operations, the meter can be suspended over a vat or tank, hung from a rack or mounted on a wall. On such processing applications it can be used directly in grounded solutions as the glass electrode is completely shielded; extra-length lead wires can be furnished to permit use of electrodes at any desired distance from the meter.

Batteries have been completely eliminated, operation is from any 110-v 50 or 60 cycle a-c outlet; a voltage-regulator corrects for fluctuations from 100 to 130 v. High stability has been obtained through improved design of electronic circuit and of galvanometer; recalibration will seldom be needed oftener than once a week. Compensation is automatic for variations from 0 to 100 C. in solution temperature and for changes in room temperature. The



clear scale is set at an angle at the top of the metal case so pH values can be read at a glance. Accuracy is 0.10 pH over the instrument's full range 0 to 14 pH.

T Oil Burner Iron Fireman Mfg. Co. has announced a new oil burner to supplement its line of industrial stokers. The aret of oil feed to the burner is governed by the company's Oil Volumeter, a positive displacement, variable volume pump submerged in the oil reservoir of the purpose of metering oil to the rotary atomizing cup. It is pointed out that the shape of the flame may be adjusted to fit porportions of the combustion



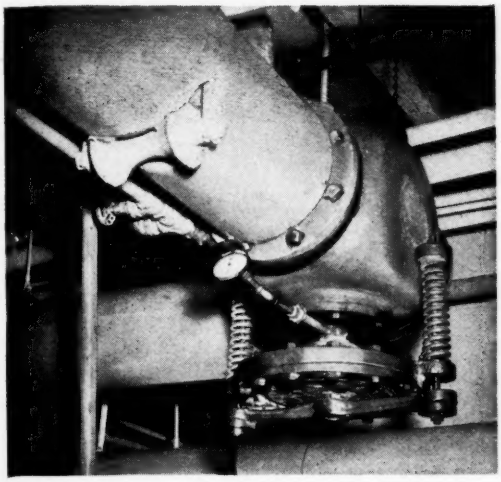
chamber. Adjustable vanes controlling the shape of the primary air stream, and thus the flame, are located well back of the oil nozzle to prevent fouling by carbon deposits.

Other features include the dual pump and reservoir and the single control lever that may be positioned manually or automatically. The burner is described as producing a steady, even flame regardless of oil temperature and viscosity.

U Aluminum Tube for Fly Ash Collection A radical departure from tubular type dust collectors has recently been announced by the Aerotec Corp. through its Sales and Project engineers, The Thermix Corp.

This tube is a permanent mold aluminum casting and was developed in cooperation with the Aluminum Co. of America. Its diameter is only 3 in., giving it excep-

IS IT HOT ENOUGH FOR YOU?



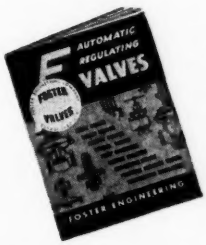
HEATING will be no problem this winter for a large electrical manufacturer who has already installed an 8 inch Foster Type J-2 double seated pressure regulator. It reduces the continuous flow from an intermediate pressure of 65 pounds to heating pressure of 5 pounds. Note that the pilot return line is large—good power plant practice at any time, but especially so when quick response and accurate regulation are required.

Eventually, somebody may figure out a practical way to store up excess summer heat for use in winter.

Until then, it looks as though we'd have to rely on the heating systems we have now, which means that they have to be dusted off and put in shape for another season or two. The logical time to check and overhaul the heating system is when it is shut down . . . in the summertime.

It's the time for *you*, because it is easier to *prevent* trouble than to take care of it as an emergency. No "cold" days for the plant with "hot", all-night repair jobs . . . no temporary makeshifts to be replaced later on.

It's the time for *US*, because we can go over your requirements with you, see that you get exactly what you need from the complete Foster line, and get the necessary regulators or parts . . . from stock . . . in time to be installed before that first call for heat.

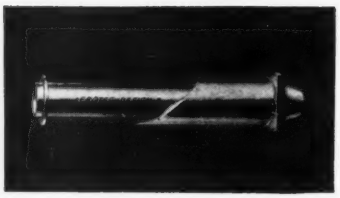


DON'T MISS these two helps — the Foster Representative and the Foster Catalog. Foster reps are trained and qualified to see that you get the proper regulator—the catalog is extremely useful in planning because it gives specifications on the various Foster valves. A 3c stamp is all it takes to tell us you want one or BOTH.

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . DAMPER REGULATORS . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . LIQUID LEVEL CONTROLLERS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN AND TRIPLE DUTY VALVES . . . VACUUM REGULATORS OR BREAKERS . . . SIGHT FLOW BOXES . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

111 MONROE STREET • NEWARK 1, N. J.



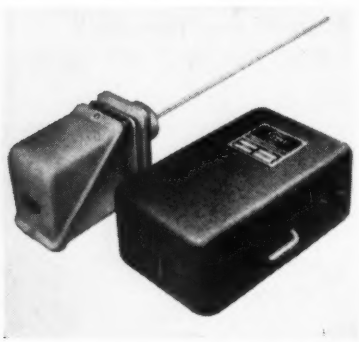
tionally high efficiency because of increased centrifugal forces, based on the formula of $F = Mv^2 \div r$. Small diameter and flush inlets permit closer spacing of the tubes and reduce eddy currents normally present with protruding wing type inlets. Aerotec claims that these features, small diameter and cast aluminum, combine to make the Aerotec Design 3 one of the most efficient, compact, light weight collectors available today.

An interesting side light on a similar Aerotec tube is the fact that it serves as the fly ash eliminator between combustor and turbine in the latest developments of gas turbines for locomotives. As a result of this performance, tests were run to determine the resistance of cast aluminum tubes to fly ash, compared to steel and cast iron tubes, with a view toward power plant applications. Amazingly the aluminum tube was comparable to cast iron on identical abrasive tests. This lighter tube is produced to closer tolerances than any other method will permit.

V Gas Flame Failure Safeguard

Combustion Control Corp. has introduced the latest Fireye flame failure safeguard for industrial gas oven, kiln, and boiler protection. Fireye Electronic Flame Rod Type 45JQ1 is said to bring to the combustion field the most advanced electronic design incorporated in several complete combustion control systems—readily applicable to all types of gas-fired burners.

Electronic Flame Rod Type 45JQ1 is used with Programming Control Type 24PJ8 for full automatic burners. It is used with Control Type 24QJ5 when only operating protection is required. Various combinations of auxiliary exhaust fan



timers and relays are also supplied to meet particular oven requirements.

Fireye is described as a foolproof electronic flame failure safeguard which actually "feels" the gas flame—maintains a constant vigil day and night against the ever-present danger of flame failure. When flame fails, it instantly cuts off fuel and can be wired to sound an alarm automatically. Fireye responds to the flame itself, not to a secondary effect of the flame.

W Resin Water-Softening Zeolite

In the early development of sodium zeolite water softeners, the zeolite employed consisted usually of processed greensand, a unique mineral occurring in nature. This mineral contains silicate compounds which have the property of base exchange; that is, when brought into contact with hard water, it exchanges its sodium for the calcium and magnesium in the water, and when saturated with these ions, it again exchanges them for sodium, or becames "regenerated" when brought into contact with salt brine.

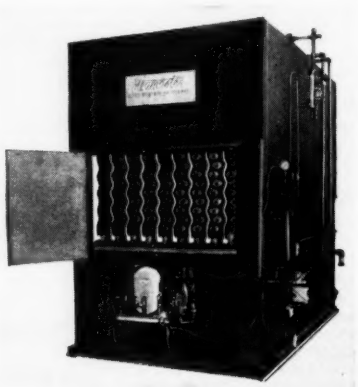
Therefore, these zeolites provide an effective means of softening water. However, these natural minerals are low in capacity and under cartain conditions impart silica to the treated water. These limitations have stimulated unremitting search for still more effective base or cation exchange materials. After many years of research with which the executives and chemists of Liquid Conditioning Corp. have been associated in the past, superior new resin zeolotes were developed which Liquon designates as Liquonex CR. This modern cation exchange material has a high capacity several times as great as some of the old-fashioned zeolites, and permits higher flow rates per square foot of area. It practically eliminates the hardness of a raw water, leaving only 0 to 2 ppm of hardness, expressed as calcium carbonate, by the most rigid tests. A further important advantage of Liquonex CR is that it is non-siliceous or carbonaceous. Therefore, it does not impart silica to the treated water, which is particularly objectionable for boiler feed.

The high capacity of Liquonex CR makes this cation exchanger of particular interest to owners of existing sodium zeolite units. This is because the capacity of such water softeners can be substantially increased by merely replacing the beds of older zeolite by Liquonex CR, without any other change in the installation. Therefore, when additional water-softening capacity is required, the substitution of Liquonex CR for the present zeolite may avoid the necessity of purchasing extra water softeners.

X Watertube Boiler

Steamaster Boiler Co. has unveiled its latest creation in a water tube boiler. Illustrated is the new 150 hp gas-fired, multiple jet, blast oil burner type boiler made for a large Eastern manufacturer.

Steamaster's doctrine in boiler making is to "incorporate big-time boiler design and performance into the small boiler field" i.e., steam boilers that are nominally under 250 hp in size.

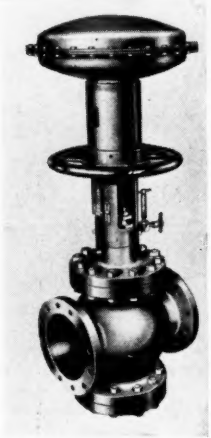


Steamaster technicians claim theirs to be "the only boiler of its size with these four 'big time' design features: water tube principle, sectional headers, longitudinal drum and inclined tubes."

The whole steamaster line of boilers from 60 hp and up now offers a choice of burner arrangements allowing the user to burn oil, gas, coal, or any combination of these fuels.

Y Handwheel Valve

The Hammel-Dahl Co. has announced its new continuously connected handwheel valve. In the past, diaphragm control valves have been installed in the main run of pipe with a block valve up and downstream from the valve. A globe valve, the same body size as the control valve, has been installed in the bypass to permit manual operation should there be an air failure, or should the control instrument, for any reason, fail in operation. The Hammel-Dahl Continuously Connected Handwheel, built integral with the allsteel superstructure of the control valve, eliminates this necessity, as it is powerful enough to operate the control valve manually, regardless of maximum instrument air pressure on the diaphragm or in opposition to the spring. It is, therefore, possible to position the valve plug by hand under any

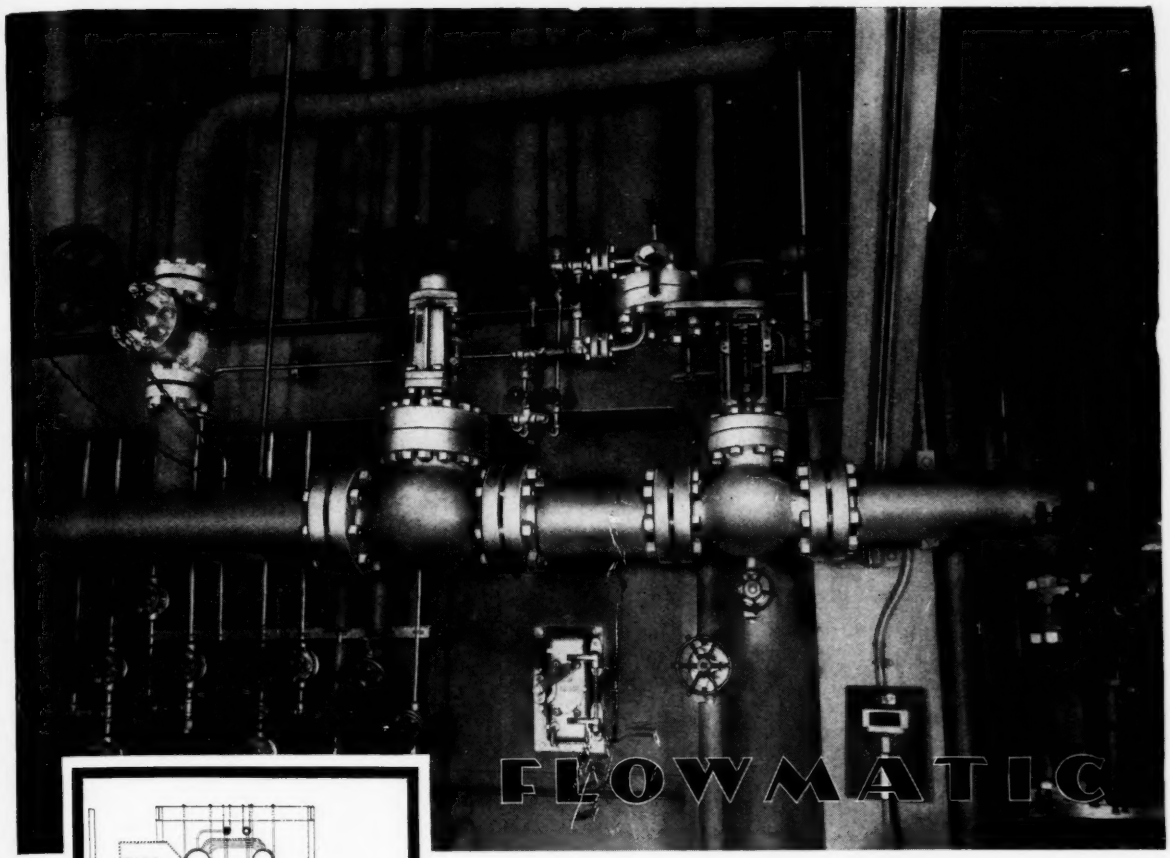


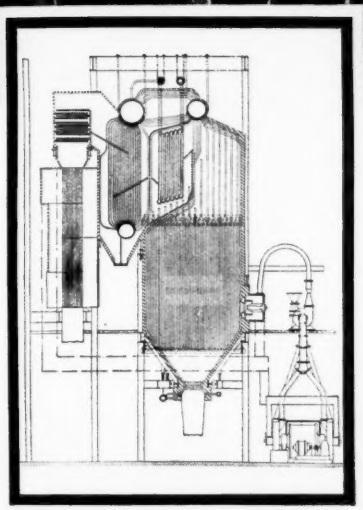
conditions, by merely turning the handwheel to the required position. The control valve characteristics are, of course, the same whether on automatic or hand control.

In valve sizes 2 in. and larger the elimination of bypasses, with the consequent saving in block valves, pipe fittings, other material, and installation labor, will more than pay for the handwheel. In fact, in many large jobs these savings have exceeded the total cost of the control valves required for the project. Hammel-Dahl handwheel construction is extremely rugged and equals or exceeds ASA standards for conventional hand-operated block valves.

In many installations it is desirable that the control valve stay at the approximate operating position should there be a power or air failure. Travel limit stops are incorporated in this design which can be set to limit the valve stroke from 0 to 100 per cent. For example, these stops can be set to permit a 25 per cent valve travel.

This 25 per cent valve travel can be located at any point in the valve stroke from fully closed to fully open.





Unit 3: 650-psi, 825-F Foster Wheeler boiler; 220,000 pounds per hour. Units 1 and 2 are similar, with half the capacity.

at Greenidge Station . . .

THIS relay-operated COPES Flowmatic closely stabilizes water level on Boiler 3 at Greenidge Station, New York State Electric & Gas Corporation. Boilers 1 and 2 have COPES simple level control, plus COPES pressure control on the turbine-driven feed pumps. The installation is fully described in Bulletin 463—Boiler Feed Control at Westover, Greenidge and Jennison Stations. Write—your letterhead, please—for this interesting Performance Report.

NORTHERN EQUIPMENT COMPANY

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Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France · *Representatives Everywhere*

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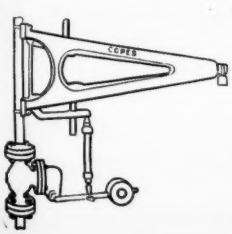
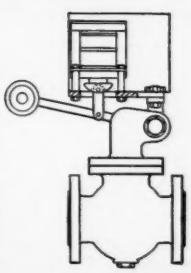


FOR SMALL BOILERS

If you have smaller boilers which carry reasonably constant loads at moderate pressures, you can get all the benefits of continuous feed and stabilized water level from COPES Type OT—a simple level control feed water regulator. Compact, it is easy to install and maintain. A proved performer in hundreds of plants. Write for information.

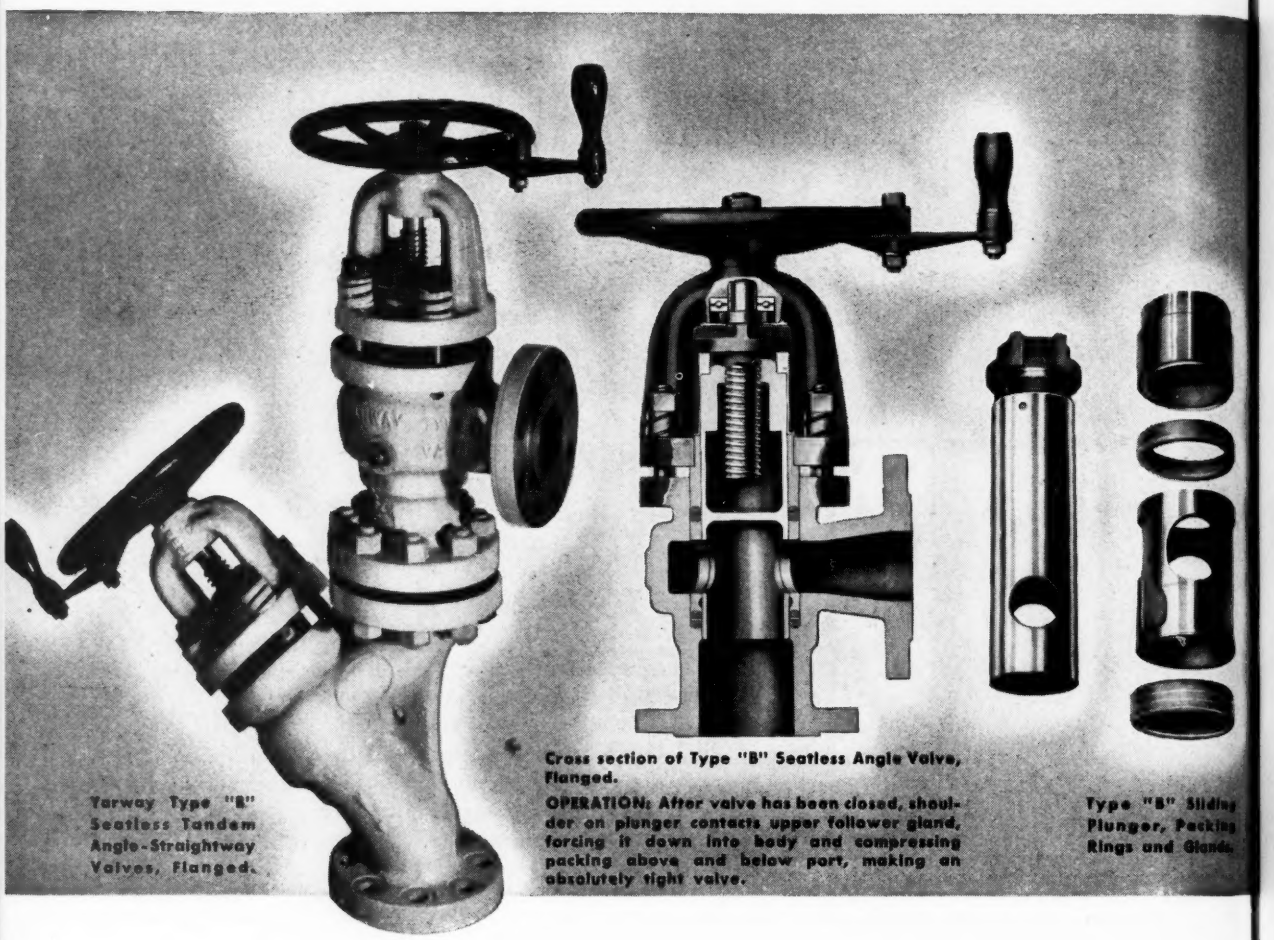
SOLENOID VALVES

There must be a good reason why important plants have gladly paid a premium for COPES Solenoid Valves. It lies in the sound engineering design, plus the rugged construction which stands up under use and abuse. Not carried in stock, each valve is built for the individual installation. Sizes: ¾ to 6 inch. Write for data.



NO SEAT!

TO SCORE...WEAR...CLOG...LEAK



Yarway Type "B" Seatless Tandem Angle-Straightway Valves, Flanged.

Cross section of Type "B" Seatless Angle Valve, Flanged.

OPERATION: After valve has been closed, shoulder on plunger contacts upper follower gland, forcing it down into body and compressing packing above and below port, making an absolutely tight valve.

Type "B" Sliding Plunger, Packing Rings and Glands.

Yarway Seatless Blow-Off Valves have become standard in more than 12,000 boiler plants because they eliminate a common source of trouble and expense with conventional type blow-off valve operation.

Yarways have no seat to score, wear, clog and leak!

This famous seatless design, first introduced by Yarway more than 35 years ago, has been constantly improved and adapted to meet modern service requirements. Mechanical and metallurgical research in Yarway's own unique Steam Laboratory anticipates changing conditions . . . assures the finest in blow-off valves for today's boiler plants.

There is a Yarway Blow-Off Valve for every pressure. For complete details of valves for pressures up to 400 psi., send for Bulletin B-424; for higher pressures ask for Bulletin B-432.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY BLOW-OFF VALVES

XUM

WHAT LEADERS SAY

Coal Looks Ahead

By GEORGE H. LOVE

DURING the last century our output per man-hour has increased almost five times while the work week has been reduced by approximately one-third. This has been accomplished by increasing the use of mineral power some 343 times during that 100 years. This mineral power, whether in the form of coal, petroleum products or natural gas, has been supplied in this country at a lower cost and in greater abundance than energy is supplied in any other major nation in the world. But since almost all the reserves of this energy are in coal, what happens to coal is a forerunner of what will happen to the country.

Needed Improvements in Coal Operations

Let us now take a look at this coal industry. First, I should like to review its primary weaknesses. There are two of these.

We must acknowledge that its national labor relations, particularly during the last six years, represent one of these weaknesses. Many would place the blame on the leadership of the union. There are others who would assign the responsibility to the government or to the coal operators. Personally, I hope that both Mr. Lewis and we of the industry, having seen enough of government in this business, are determined to conclude an agreement and move on with the tremendous job which the nation has a right to expect from coal.

The other fundamental weakness of the coal industry revolves around the very make-up of the industry itself. Picture an industry with a sales volume less than half that of the steel industry and yet with nearly a hundred times as many producers. The bituminous coal industry has some 12,000 mines scattered over some 23 states, and these mines vary in size from those employing two or three men to those with payrolls of a thousand or more. Six thousand different companies are normally spinning around in a whirlwind of price competition with their neighbors, with other districts, and with other fuels.

In all but war and boom periods, capacity exceeds consumption by a large margin in the coal business. So most of the time we have 6,000 companies trying to manage a business with a tremendous over-capacity in which it definitely pays to operate at a loss rather than to close down.

Of course, we recognize the evils of monopoly, either in industry or in labor, but the picture at the other extreme, with its chaos and waste, has its evils, too.

Revealing Comparison

In the oil industry, the chief competitor of coal today, one company has assets equal to those of the whole coal industry and earns more than the total coal industry even in times of peak demand. In rubber, four companies produced 70% of the total volume. One company is reported to supply 60% of the nation's electrical generating capacity. Three companies in the automobile industry supply over 75% of the automobiles. There is a similar situation in aluminum, steel, chemicals. In coal, however, it would take the top four commercial companies combined to equal even 10% of the productive capacity. The coal industry's scattered, heterogeneous condition from the financial, the management and the geographical standpoints, is undoubtedly the most inherent and fundamental problem we face.

Coal Miners' Wages

Our industry has been dramatized as the center of low wages and destitution. Here is a case where the public understanding has lagged far behind the facts, and I must admit that we share in the responsibility for this misunderstanding.

What are the facts on wages?

Just last week I noticed in a Washington, D. C., newspaper figures on wages, issued by the Bureau of Labor Statistics. These showed that the highest wages weekly earnings of any industry in January this year was the coal industry, where the men averaged $69.58 per week. It was interesting to note that the nearest aproach to this average in the coal industry was the weekly average of $60.00 In rubber. Steel was $50.00 and the railroads, $58.70.

It might be added that the average hours worked in coal during 1946 were 46.7, although work was available for most of the men for 54 hours. In 1945, the latest year for which comparable figures are available, the English miner earned about $23 per week as compared with the $55 average weekly paycheck received by the miner in this country. Incidentally, our industry's total wage bill in 1946 exceeded a billion dollars.

The Safety Factor in Mining

The recent Centralia disaster has been used to indict the coal industry for inhuman disregard of the safety of its workers. Safety is the second of these ills about which I want to talk briefly. Allow me to say with as much emphasis as I can that there is no industry in the world to which the word "safety" means more in the way of planning and effort and training on the part of management than it does to the coal industry. Still I must admit that we can never lose sight of the fact that coal mining is hazardous. Actually, there is continued fighting and striking as a result of our efforts to get men to obey safety regulations.

Our Coal Mining the Most Advanced

Finally, let me point to the third

(*Continued on page 130*)

George H. Love is president of Pittsburgh Consolidation Coal Co. He was born in 1900 at Johnstown, Pa., was graduated from Princeton in 1922, and from Harvard Business School. After four years experience in the investment field, spent in New York, Boston, Chicago and St. Louis, he returned to Pittsburgh in 1926 to become assistant to the president of the Union Colleries Co., one of the district's smaller but progressive coal producers. Upon the death of the company's president in 1933, Mr. Love was elected to the post. During the depression he pushed through a program of improvements that resulted in a new earnings record for the company. In 1943 Mr. Love became the executive vice president and chairman of the executive committee of the Consolidation Coal Co.

From his experience at Union Colleries, Mr. Love became convinced that the way to cure some of the longtime ills of the ailing coal industry was by the formation of companies strong enough financially to effect greater mechanization of mines, to improve marketing practices, and to undertake research so long and badly needed in coal.

He became president of Consolidation Coal Co. in 1944 and since that time the company has acquired, through merger, the Union Colleries Co., Pittsburgh Coal, the Hanna Coal Co.; the combined output of the three and their lessees exceeded 30,000,000 tons in 1946.

Mr. Love is a member of the boards of M. A. Hanna Co. and of the Mellon Bank & Trust Co. of Pittsburgh. In 1945 he was an industry member of the National Management-Labor Conference in Washington, representing coal. The comments given here are from his recent speech before The Executives Club of Chicago.

Accurate Field Testing Of A 5000

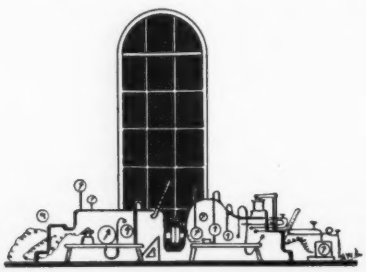
By F. H. WILEY,
Electrical Superintendent,
Department of Public Utilities
Colorado Springs, Colorado

EARLY IN 1946 a 5000-kw turbine generator unit was made ready for service in the Municipal Power plant of the City of Colorado Springs, after having been delayed for several years by war conditions. The unit was of General Electric manufacture designed for 400 psi, 750 F., 1½ in. Hg, absolute on the steam end and 3-phase, 60-cycle, 6900-v, 80 per cent power factor on the electrical end. The unit has a direct connected exciter and runs at 3600 rpm.

It was desired to make accurate water rate tests on this unit and because of congested conditions at the factory, it was decided to make the tests in the field using the ordinary system load. The test was conducted by W. W. Johnson, Test Engineer in the Turbine Division at the Lynn Works of the General Electric Co. Much of the data in this article were taken from his complete report.

Other units in the plant consisted of another 5000-kw unit and two 2500 kw units which had run almost continuously and with practically no maintenance throughout the five war years. Making the test in the field was not considered a hazard to service even in the event of a breakdown of one of the old units on which maintenance work was long overdue, because making the test "hook up" would keep the new machine unavailable for service for only short periods.

Steam is normally supplied for the plant from two gas-fired boilers delivering into a common steam header. To keep the test load constant on the machine under test, its governor was gagged and the variations in system load taken by the other machines whose governors were in service. The governor gag was of course arranged so that it would still function to close the valves in case of a slight overspeed which might result from the loss of more load than the other machines could drop.



To keep the steam conditions to the machine under test as constant as possible, the boiler feeding the steam header nearest the off-take for this machine was put on hand control and the automatic control on the other boiler allowed to handle the system swings. With this arrangement, steam pressures and temperatures to the machine under test were maintained within limits of plus or minus about 2 psi and 5 F, by occasional hand adjustment of the fuel and air to the one boiler.

All instruments used in the test were shipped from the turbine test department and consisted of 12 dead weight pressure gages, 4 pressure type manometers, 15 open manometers, a potentiometer for thermocouple temperature measurements with an accuracy of ¼ degrees F, 7 thermocouples with leads, a mercury barometer readable to 0.001 inches, a supply of transparent plastic tubing and rubber tubing for low pressure connections, metal tubing and valves for high pressure connections, 3 two-pen recording pressure gages, glass thermometers, 2 calibrated flow nozzles with flanges and adjacent piping, 3 current transformers with leads, 3 potential tranformers, an ammeter and a voltmeter. In addition, 5 single phase indicating wattmeters were brought along, carried by hand to insure careful handling. The complete shipment weighed about 4500 lb, and occupied 26 boxes in all.

All of the instruments requiring calibration were calibrated before leaving the factory and again after returning to the factory.

Extreme care was exercised in adapting the plant piping for purposes of the test. The steam flow was determined by measuring the condensate from the hotwell so it was necessary to be sure no condensate escaped the measuring nozzle or that no other water entered the system.

Precautions to Assure Accuracy

It may be of interest to enumerate the various precautions taken to assure the greatest possible accuracy for this test. Blanking plates were inserted in the 3 bleed line flanges where they connected to the turbine casing. This method was used instead of merely closing valves in the bleed lines because it eliminated the pockets in the piping for the possible condensation and collection of steam which should go through to the condenser.

The drip return lines from the heaters were shut off and the lines disconnected so no water could enter the condenser from this source; merely closing a valve was not relied upon as a shut off in any case on account of the possibility of a leakage. The same was done to all other drip and trap lines that discharged into the condenser or hotwell. The drain line from the secondary air ejector which could discharge at atmospheric pressure was disconnected from the hotwell and temporarily piped to the sewer, while the drain from the primary air ejector which had to discharge into a vacuum was disconnected from the hotwell on the machine under test and temporarily piped to the condenser on one of the other machines in the plant.

The atmospheric relief valve was normally arranged for sealing with condensate and the gland seal condensers were arranged to use condensate for condensing water. The normal supply line to these items was left intact as it was taken off the condensate discharge line ahead of the measuring nozzle and was then returned to the hotwell so that this water was merely re-circulated and did not enter into the measurements. Live steam to the seals was shut off except when required at light loads and it was then measured by an orifice.

The air discharge lines from the air jets were opened into the room because they normaly discharged into the atmospheric relief line which in turn drained back into the hotwell with the relief valve sealing water. The steam used in the jets could thus have condensed and added water to the condensate which did not belong there.

All connections between the hotwell or condenser to the surge tank were blanked off.

The spare condensate pump was left connected but re-circulation through it prevented by a check valve and by closing tight the gate valves on both suction and discharge sides of the pump.

The possibility of steam from the auxiliary oil pump condensing in the atmospheric relief line and returning to the hotwell with the relief valve sealing water was eliminated by closing the admission valve and removing a plug in

kw Turbine Generator Unit

The most interesting thing about running a test on a turbine generating unit is the accuracy involved Every possible precaution has to be taken, both in measuring the steam input and the electrical output. Usually, turbine generating units are tested at the factory before they are delivered. In the case described here, however, it was necessary to test the machine at the station where it was installed, using the regular system load. The way in which this test was conducted makes an interesting story

the exhaust of the oil pump turbine and watching that it did not blow steam and that the turbine remained cool.

A connection for recirculating condensate through the interafter condenser during the starting period was shut off by two valves in series after the machine was supplying enough condensate to cool the inter-after condenser without recirculation.

The first series of test runs made with these piping changes showed slightly erratic results. A possible cause was thought to be the irregular return of condensate from the condenser to the hotwell. The hotwell is of the deaerating storage type and consists of a horizontal tank nearly as large as the condenser and mounted directly below the condenser. The connection between is a 12-in. opening. To eliminate any posibility of air coming out of the hotwell interfering with the downflow of the condensate, a 4-in. vent was installed directly from the hotwell to the air off-take line. This proved later to be a mistake as the air thus handled did not go through the air cooling section of the condenser and interferred with the maintenance of a good vacuum. The erratic flow of condensate was found to be due to an undersize drain for the atmospheric relief valve sealing water. Instead of draining out and returning to the hotwell as it was supplied it was found to be backing up along the atmospheric relief line where a considerable amount of condensate would accumulate and then drain out in irregular manner. Adding a better drain line eliminated the trouble.

On account of the large surface of condensate in the storage hotwell, pains were taken to make accurate measurement of the level. Two additional gage glasses were installed and a vernier reading to 0.01 in. was fitted to the station gage glass. A calibration curve was made for the tank by filling with water and then weighing it, one barrel at a time as it was drained out so that if the level in the tank should vary during the tests, the exact variation in the amount of condensate would be known. One of the gage glasses proved useless

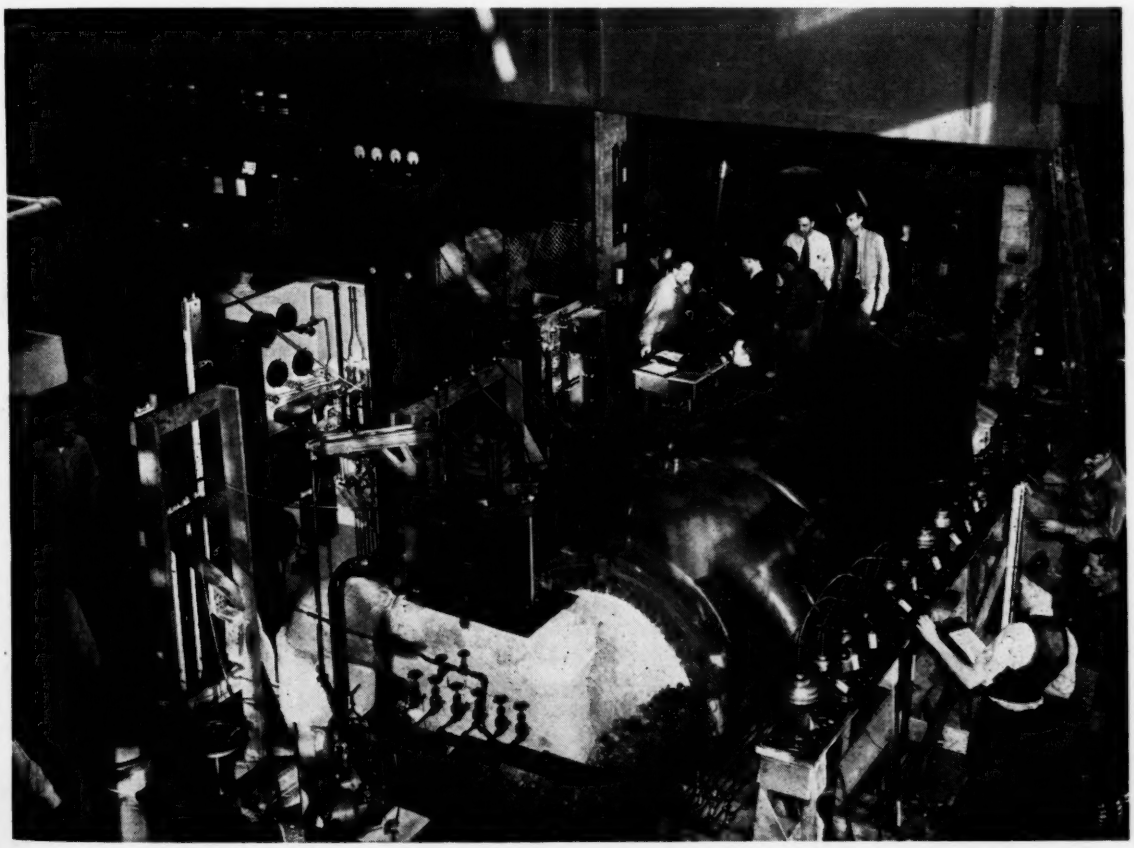


Fig. 1. Turbine-generator unit under efficiency test, showing test equipment. (Photo, F. Baker, Colorado Springs)

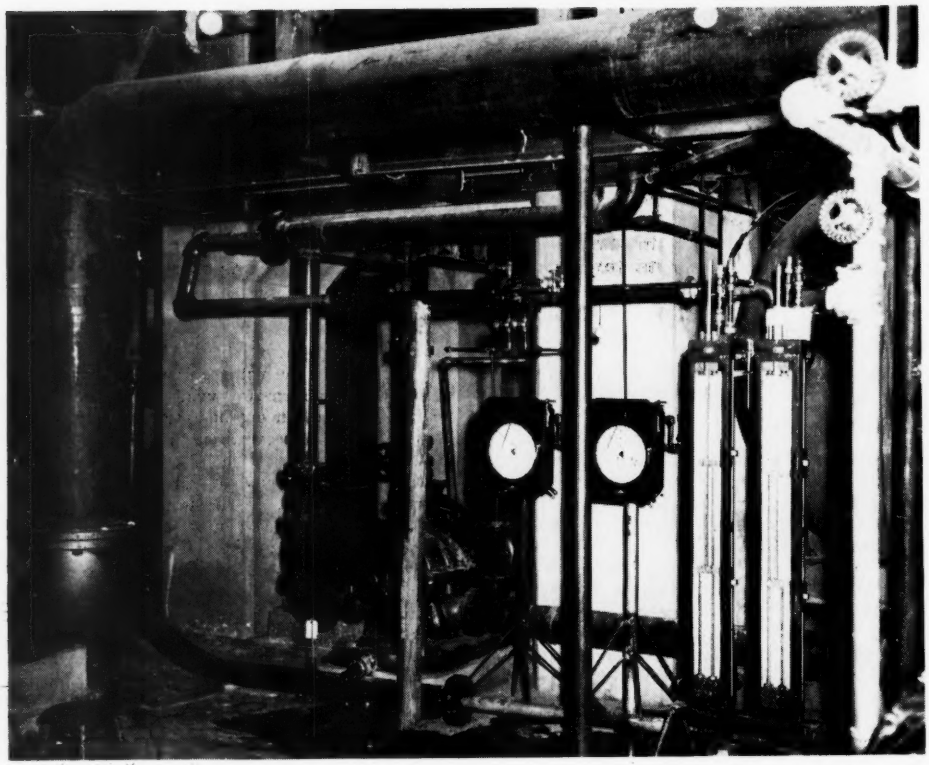


Fig. 2. Measuring the condensate from the turbine. This photograph shows the flow nozzle and piping with measuring equipment. (Photo, F. Baker, Colorado Springs)

as one end of it was connected into the condensate discharge line below the the tank so that when operating the velocity of the water and friction loss affected the reading. The other two gage glasses showed consistent and reliable results. During the adjusting period preliminary to each test run a throttling valve in the discharge line from the condensate pump was adjusted so that condensate was removed from the hotwell at the same rate it entered, so that with occasional slight adjustments during a few of the runs, the hotwell level was kept very nearly constant.

Another precaution taken to be sure that a measurement of the condensate would be a true measurement of the steam was to test the condenser for circulating water leakage. To do this the circulating water pump was run for three hours against a throttled discharge valve to develop as much pressure in the water side of the condenser as possible. The manhole in the hotwell tank was left open so any condenser leakage could be observed, but in this case there was none. Even the drips from the packing glands on the condensate pump were caught for a timed interval and weighed but were found to be insignificant.

This description has so far been all on the precautions taken to change an ordinary operating installation into an accurate test set-up. The next thing to describe is the actual test procedure.

The flow of condensate is one of the primary measurements. This was taken in accord with ASME Test Code Standards with two calibrated long radius low ration nozzles with throat taps, mounted between flanges in the same run of 2-in. pipe with which they had been calibrated at the factory. The smaller nozzle was inserted for the ¼, ½ and ¾ load runs and then replaced with the larger nozzle for a check of the ¾ load run and for the ¼ and ⅝ load runs. The nozzles had four sets of taps, the two side sets being connected to two pressure type mercury manometers with water filled connections, the bottom tap to a recording differential pressure gage and the top tap used for bleeding air out of the lines. Readings on the manometers were recorded every minute during a test run which lasted ordinarily for 60 minutes after a preliminary adjusting period of about the same length of time at the same load. The charts from the recording gage were valuable in determining the duration of variations which

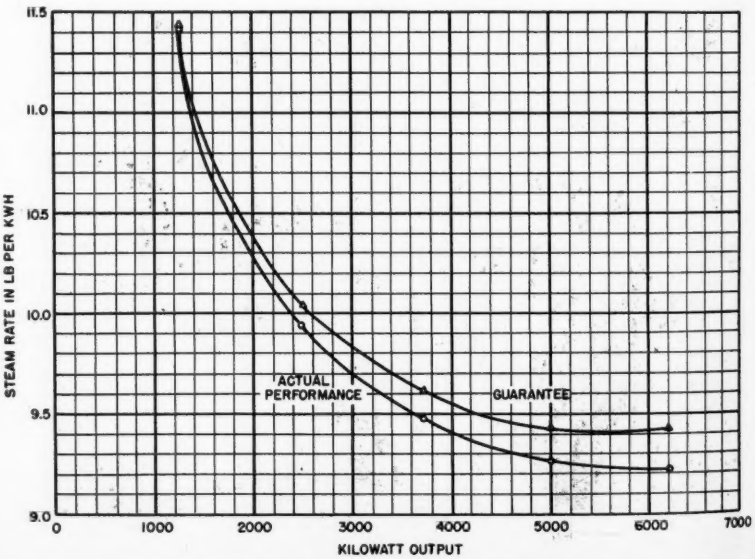


Fig. 3. Steam rate chart of actual test results showing that the actual performance was notably better than the manufacturer's guarantee

showed in the manometer readings. In connection with these readings a record was made very 5 minutes of the hotwell level indicated on each of the 3 gage glasses rigged up for that purpose. These readings together with occasional adjustments of the condensate flow valve and with keeping the air bled out of the lines kept three observers busy.

Measurement of Electrical Output

The other primary measurement was the electrical output. Three test current transformers were connected in the "wye" leads of the generator and mounted inside the air cooler ducts along with two potential transformers which were connected to the generator line terminals. These transformers and the current leads were all calibrated with the identical instruments with which they were used. The potential transformers and two current transformer were used to feed four single phase indicating wattmeters, two meters in series in each current lead so that two separate sets of readings would be had for checking against each other. The third current transformer fed an ammeter. Wattmeters were read every minute. As a check, a circuit "analyzer" consisting of polyphase wattmeter, ammeter, voltmeter and power factor meter was connected in the regular station metering circuit and read together with the regular switchboard meters. These instruments indicated a little higher output than the test instruments, probably on account of the added burden on the instrument transformers. The readings were useful, however, in maintaining load and power factor at the desired point. Power factor was maintained by occasional adjustments of the voltage regulator. The electrical readings required four observers.

Making Pressure Measurements

A number of pressure measurements were made by means of calibrated dead weight gages for the higher pressures and mercury manometers for the lower pressures. These were turbine initial pressure, the nozzle bowl pressures, 1st, 4th, 8th and 11th stage shell pressures, packing cell pressures, and the pressures ahead of the orifices used to measure packing drain flows. The line to these gages were all carefully filled and maintained full of water and readings were made every five minutes. Exhaust prssure was read on four separate mercury manometers, each connected to one of four taps spaced about equally around the exhaust nozzle and about 10 in. above the condenser flange. The connections to the manometers were made with transparent tubing which made the detection of moisture in the lines easy. To keep the moisture, out small bleed holes in the connecting lines were opened between readings just above the manometers and then closed with adhesive tape to take readings which were taken every five minutes. The exhaust pressure was held at the guarantee point by bleeding air into the air offtake line ahead of a throttled valve. Such air should not be bled into the condenser where it may pick up an appreciable amount of vapor which would be carried out with the air and thus not be measured with the condensate. Two independent barometer readings were made every 15 minutes to use with the exhaust pressure readings in computing the absolute exhaust pressure. In connection with the barometer used, it is interesting to know that the re-calibration after return to the factory showed no change in calibration although the barometer had been shipped 4000 miles and unpacked, inverted, and set up several different times. The pressure readings required four observers.

Steam temperature to the turbine was measured ahead of the throttle by two calibrated thermocouples in finned wells, using a Leeds & Northrup potentiometer. This instrument was also connected to thermocouples reading the steam temperatures in the packing drain lines which data was necessary in computing the steam flow through these lines. Mercury thermometers were used to read condensate temperatures after the flow nozzle and temperature of the condensate from the gland seal condenser. Temperature readings were made every five minutes and required one observer.

Measurements were also made of the packing drain flows by means of sharp edge orifices inserted in the drain lines and measuring the differential pressure across them by means of pressure type manometers. This data together with the temperature and pressure readings taken at these orifices and described above completed the data necessary to compute packing drain steam flows. One observer was required to read the differential manometers.

The accompanying photograph shows the unit with part of the test equipment set up and reminds one somewhat of a lady getting a permanent wave.

The first series of test runs started with full load, then ¾ ½ and another ¼. Preliminary calculation of results showed inconsistencies in condensate measurement and indicated the need of better hotwell level measurement which was accomplished by adding the second two gage glasses described before.

The next series of runs started with ¼ load, then ¾ and ½. Results were more consistent but still not satisfactory. After this the hotwell vent and extra relief valve drain were added.

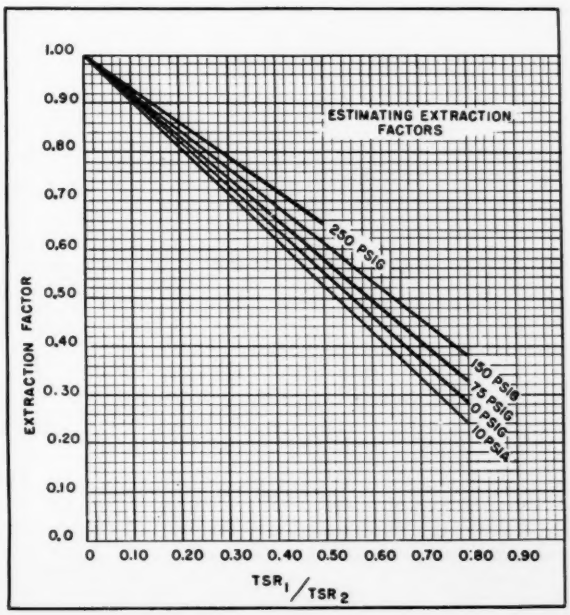
The next series of runs were at ½, ¾ and ¾ load with the large condensate measuring nozzle which was then replaced by the small nozzle and runs made at ½, ¾ and ¼ load. These six runs were very satisfactory and the data taken from them used to represent the actual performance of the unit. The accompanying graph of steam rate plotted against load shows the actual performance which was appreciably better than guarantees.

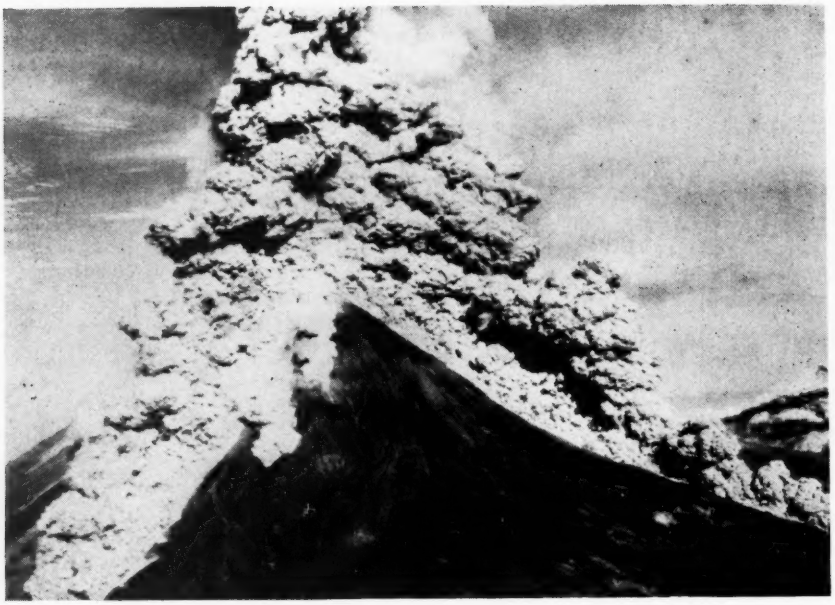
After the test was completed the turbine cover was removed for inspection and the checking of clearances. Everything was in good order and clearances substantially the same as when measured at the factory before shipment.

The general conclusion drawn after participating in the conducting of this test and studying the data obtained is that the accuracy of it was of the highest order and that the accurate testing of a turbine of this size in the field is an entirely feasible procedure.

HOW TO ESTIMATE TURBINE PERFORMANCE WITH UNCONTROLLED EXTRACTION — A CORRECTION

WE REGRET that a rather serious error occurred in presenting Mr. Pollard's article under the foregoing title in the April issue. In redrawing the graph, Fig. 3, on page 76, the scale along the vertical axis was displaced one major division. In other words the point of conversion of the five pressure lines should be 1.00, as shown in the corrected drawing at the right. If you save your copies paste this corrected drawing over the one which appeared on page 76 of the April issue





An "Educated" Piece of Metal

By **J. F. MEYERS**, Black, Sivalls & Bryson, Inc., Kansas City, Mo.

A VOLCANIC ERUPTION may be fascinating to see—from a distance—but the havoc and destruction it creates hardly makes the spectacle worthwhile. A pressure vessel—any type of container where pressure is generated or stored—can very easily take on the aspects of a volcano if it is not adequately protected by a suitable pressure relief device. Almost everyday newspapers present accounts of pressure vessel explosions—sometimes it may be merely a coffee urn in a restaurant but even such an explosion can result in loss of life. Such an explosion occurred in Chicago several years ago, killing several people. In nearly all cases, these explosions occur because of inadequate pressure relieving capacity, improper material, or faulty operation. Sometimes they result from the operator's desire to squeeze out another few pounds beyond the safe limits of the device involved. In the majority of instances these disasters could be avoided.

The molten lava which issues from a volcano feels its way under the crust of the earth until it finds a weak spot. With pressure vessels we cannot depend upon natural weak spots; we must provide them ourselves. We must install some sort of a relief device which will "let go" at a predetermined pressure and afford ample relief before damage occurs.

Various kinds of pressure relieving devices are available. These include safety valves held in place by springs or weights as well as other mechanical arrangements but one of the simplest and perhaps most effective pressure relief devices is the safety head, built for insertion in the wall of a pressure vessel or in a line connected to the vessel. A safety head of this kind is shown in Fig. 1. It is very simple in construction and action; consisting of a pair of clamping flanges, a pre-formed rupture membrane and the necessary studs and nuts for clamping the parts together.

This particular head was developed some 20 years ago for use in the oil and gas separators of the company that now manufactures them.

The rupture disc can be regarded as an educated piece of metal since it knows exactly when to burst; it has been conditioned in advance to do so. Usually it has a guaranteed bursting pressure tolerance of plus or minus 5 per cent of its designed rating. In most cases the variation in bursting pressure will be within 1 or 2 per cent.

The rupture disc is placed between specially designed flanges which are bolted snugly together. The safety head is now ready to become an intregal part of the pressure system. Figure 1 shows how the disc looks when it is installed. In Fig. 2 you see the disc burst after being subjected to over-pressure. Note the full pipe size, unrestricted opening after rupture.

To suit different conditions it is necessary to have a wide variety of metals available from which to manufacture the flanges and rupture discs. Carbon steel, nickel, stainless steel, monel, copper, aluminum, and such precious metals as fine silver and platinum are a few of the metals used. Selection of material depends mainly upon corrosive and temperature conditions prevailing at the point of installation.

In determining the proper bursting pressure required for the disc it is necessary first, to secure from the operator his actual operating pressure as well as maximum temperature conditions and

Fig. 1. This shows how the rupture disc looks as installed

Fig. 2. Here, you see the disc burst

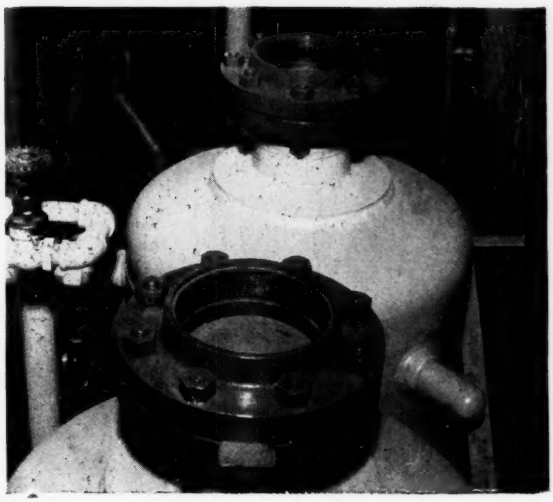


Fig. 3. In this installation the safety head is used as the sole pressure relieving device on air starting tanks

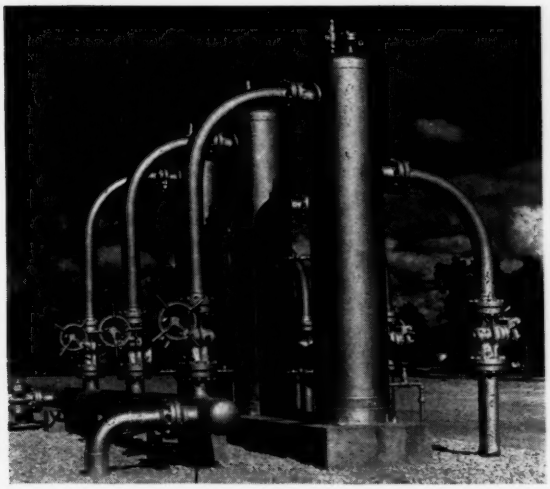


Fig. 4. Here, safety heads are used to "back up" relief valves on an outdoor installation of gas scrubbers

whether vacuum is likely to be encountered. It is standard practice to use a rupture disc with a bursting pressure 50 per cent above the normal working pressure. This differential of 50 per cent strikes a "happy medium," enabling the operator to receive a good service life from the disc without frequent replacements. If the pressure is pulsating it is good policy to maintain a wider margin between the two pressures, provided the vessel, pipeline, or whatever the pressure container may be will satisfactorily withstand a higher disc setting.

When the safety head is used as the primary relief device, the rupture disc setting should not exceed the design pressure of the vessel. The ASME Unfired Pressure Vessel Code states "The safety valves or rupture discs, when used, shall be set to operate at not to exceed the maximum allowable working pressure stamped on the vessel and the relieving capacity shall be sufficient to prevent a rise of pressure in the vessel of more than 10 per cent above the maximum allowable working pressure." Similar acceptance of relief devices is covered by the ASRE Code. If the safety head is used as a supplementary relief device it can be set above the design pressure of the vessel but preferably not above the test pressure.

How the Safety Head is Used

1. Sole pressure relief device—Fig. 3
2. Supplement to relief valve—Fig. 4
3. Beneath relief valve—Fig. 5

On some types of pressure systems it isn't necessary to have a shut off after over-pressure relief, thereby permitting the safety head to be used by itself.

When the safety head is used to "back up" a relief valve the valve setting will usually be slightly above the normal working pressure, following through with the margin of 50 per cent on the rupture disc. Figure 6 shows a typical safety head and relief valve installation.

Where corrosive or gummy materials are encountered it is often desirable to install a safety head beneath the relief valve, thereby affording protection to the valve parts since the movable mechanism is isolated from the vessel contents at all times except during discharge.

Safety heads are used under both pressure and vacuum conditions. When vacuum is encountered and the rigidity of the disc is not sufficient to withstand the vacuum stress it is necessary to have "tailored" to the pressure side of the disc a vacuum support (Fig. 7). You will note that the support is "pie-shaped" and divided into segments, thereby permitting pressure to be in contact with the disc at all times. The support opens up at the same time over-pressure fractures the disc. The pressure flow is in no way retarded by the vacuum support.

In some installations it is desirable to eliminate the vacuum support and install the safety head upside down. In case of any pressure the disc would be reversed and rupture at its designed rating. This practice is not practical on systems operating alternately on pressure and vacuum.

It is a proved fact that violent explosions can occur in compressed air systems. A number of reasons can be given for the creation of this abnormal pressure—a vaporized oil-air mixture becoming ignited by a hot fleck of carbon, clogged filter, leaky valves, mechanical failure, etc. In most cases the compressor, pipeline, or receiver is damaged due to inadequate pressure relief devices. Since a large volume of air is to be discharged in a fraction of a second it is desirable to have a pressure relief device trat affords a large, unrestricted opening. The photograph showing the large horizontal receiver in the Central New York Power Plant at Oswego, New York (Fig. 8) is a good example.

Safety heads used at the compressor discharge or at a turn in the air line are usually extended on a tee which permits the pressure flow to be in direct contact with the disc without making a turn. The possibility of over-pressure disrupting the equipment is greatly reduced with this type of arrangement.

Often we give too little thought to

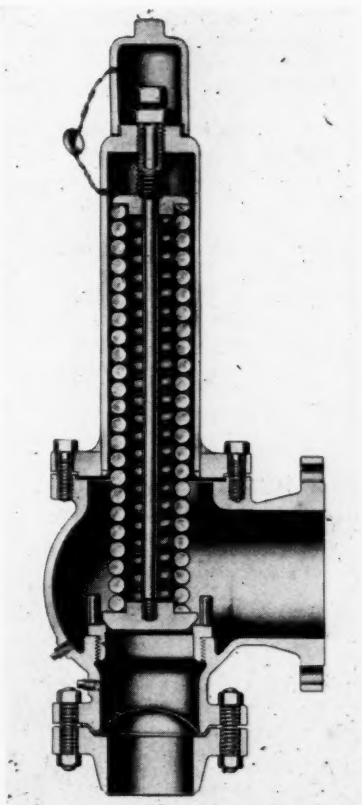


Fig. 5. A section, showing a safety head installed underneath a relief valve

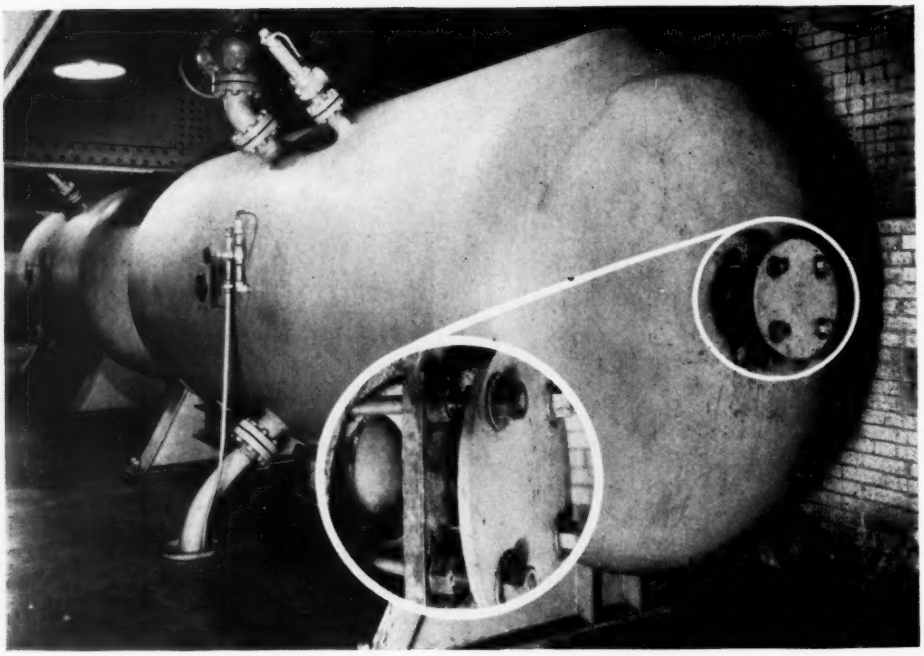


Fig. 6. Safety heads backing up relief valve on a soot-blowing air receiver. Baffle plate on safety head retards recoil as well as preventing anyone coming in line with the direct discharge. Photo, Courtesy, Central New York Power Co.

the safe operation of our pressure equipment—not taking into consideration that we can not strain the "guts" out of a piece of pressure equipment and expect it to stand up day after day without failure. A fitting epitaph would be—

Beneath this sod there now doth lie
The mortal remains of a stubborn guy
The inspector warned the tank would burst
But he didn't believe in safety first

One may question as to how the approximate bursting pressure of the rupture disc can be predicted. There is one way—only one way—to assure the bursting pressure of a rupture disc—burst specimen discs from the same sheet of metal. If these specimen discs burst consistently close to each other, then we know the bursting pressure of additional discs made from the same section of metal. Over 75,000 rupture discs have been fractured in test.

A great deal of care and experience goes into the design and manufacture of these rupture discs and once they have been put through the tests on the "proving ground," a simple sheet of metal, truly, becomes an educated piece of metal.

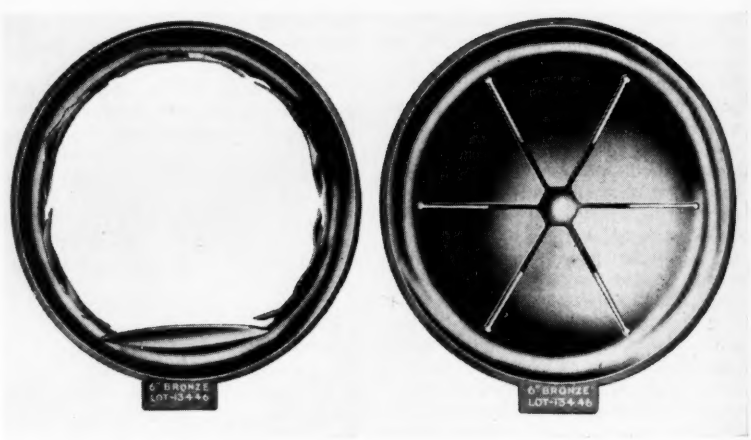


Fig. 7. Vacuum supports showing full opening after rupture disc bursts

NEW NATURAL GAS STORAGE METHOD

National Tube Co., U. S. Steel subsidiary, has collaborated with the Public Service Co. of Northern Illinois in a project experts believe will revolutionize the natural gas storage field. In short, the project provides for gas storage underground rather than in the conventional storage tanks above ground, and insures larger subterranean natural gas storage facilities in the years to come.

The utility last fall completed a pilot installation of subterranean gas storage at Kankakee, Ill., and will start this week on installation on a 160-acre tract at Wolf and Foundry roads at Mount Prospect, Ill., nearly 40 times as large as the Kankakee pilot installation. National Tube, which furnished most of the pipe for the wartime "Big Inch" oil line, built the high-pressure, torpedo-like, pipe sections for the Kankakee project and is now finishing the underground pipe for the Mount Prospect installation.

At Kankakee the pilot plant has a capacity of 1,250,000 cu ft of gas, while at Mount Prospect the finished project will have a capacity of 40,000,000 cu ft.

Inasmuch as there previously were no installations of this kind to guide them, engineers of the utility company and National Tube pioneered step by step in the development, first in blueprints and then by experimentation. When blueprints and preliminary tests of pipe installation had been determined, construction of the pilot plant at Kankakee proceeded according to schedule.

Finally, with the Kankakee installation completed, but before actual gas was introduced into the underground storage system, a conclusive test was made with air. The test was successful and natural gas was then forced into the sections under pressure, and the Kankakee plant was in operation.

The pipe sections made by National Tube for the underground gas storage are fashioned from 24 in. seamless molybdenum steel pipe.

Modern Power Line Carrier Equipment

Scope of modern power line carrier equipment . . . Communication Equipment—Simplex and Duplex Systems . . . Carrier Relaying Equipment . . . Carrier Telemetering and Load Control Equipment . . . Supervisory Equipment . . . Modulation Systems—Amplitude Modulation; Frequency Modulation . . . The Future of Power Line Carrier . . . Details of Commercial Systems

By **R. C. CHEEK**, Central Station Engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa.

TODAY it is possible to select the proper characteristics for power-line carrier equipment through the use of a few simple emperical rules and, by combining several standard component units into a single compact assembly, provides a satisfactory circuit with relative certainty for such power-system functions as telephone communication, protective relaying, telemetering, load control, or supervisory control. The variety of applications of carrier on power systems precludes the possibility of manufacturing complete standard assemblies for every need. Instead component units are standardized and assembled to fit individual requirements.

The number of individual component units available runs into the hundreds; so that the variety of combinations is practically unlimited. In addition to differences between the combinations of functions they perform, individual assemblies may differ in power supply voltage or frequency, power output, type of mounting (indoor or outdoor), and in many other characteristics. The assembly of Fig. 1, for example, is intended for carrier relaying, telemetering, sleet detection, and emergency communication, and the component units required to perform these functions have been selected and combined accordingly into a single assembly.

Power line carrier refers to the method of superimposing high frequency currents on power lines carrying normal power current. Such high frequency currents are used for communication; i.e. telegraphy or telephony, relaying, telemetering, etc. and interfere in no way with the operation of the power line. A complete system of carrier equipment consists of a transmitter (similar to a small radio transmitter) at one end of the line, and a receiver (similar to a radio receiver) at the other end. The equipments are connected to the power line through a capacitor or other coupling device which permits the high frequency "carrier" current to flow in or out of the power line but which at the same time prevents the power current from passing into or through the carrier equipment. In recent years carrier equipment has become quite standardized and in this article by Mr. Cheek which was originally delivered before the Mid West Power Conference in Chicago this year, he describes briefly the various types of equipments available and their uses

Communication Equipment

Probably the widest variety of individual assemblies occurs in the application of power-line carrier for telephone communication. Modern power-line carrier communication assemblies are available that will give telephone service equal to that obtained from the best private automatic telephone exchanges, providing dial calling with such features as the busy signal, a revertive ringing tone, and an automatic disconnect signal. For less elaborate communication systems, simpler assemblies with simpler methods of calling are available.

Despite the variety of assemblies, all carrier communication systems can be classified as either simplex or duplex systems. A simplex system is one in which transmission can proceed from only one station at a time during a conversation. In a simplex system all stations send and receive on the same frequency. Means must be provided for turning off the receiver and energizing the transmitter at the beginning of a transmission. In the simplest type of simplex system, this switching operation is performed manually by means of a pushbutton on the telephone handset. Such a system is called a manual simplex or push-to-talk system. If the switching operation is performed automatically by equipment within the carrier assembly, the system is called an automatic simplex system.

Simplex systems have the advantage of requiring only a single frequency for all the stations on a given channel. This is an important consideration today, because the widespread use of carrier equipment has led to an extremely crowded condition of the carrier-frequency spectrum on most power systems.

Modern automatic simplex assemblies are ideal for extensive communication setups in which the carrier channel forms a part of the overall telephone communication system. In the minds of some users of carrier communication equipment, some prejudice exists against the automatic simplex system. This prejudice derives from the faulty performance of some of the earlier automatic switching systems, whose operation sometimes left much to be desired. The inability of the listener to interrupt the speaker is also an objection in the minds of some users to the automatic simplex system. The modern automatic simplex assembly of Fig. 2 eliminates all such objections. The switching operation, accomplished electronically, takes place so rapidly that a party speaking is heard by the other party within less than 5 milliseconds, and not even the first syllable of the outgoing speech is lost. The operation of the system can be made so fast that the listening party can interrupt the speaker between words of a sentence. At the same time, the transfer is made so quietly that the ordinary user is unaware of the fact that switching operations are taking place.

In the duplex system, the carrier signal is transmitted continuously from both stations during the conversation. Two frequencies are used, transmission and reception taking place on different frequencies at each station. No switching operations are necessary during the conversation, and a party speaking can be interrupted at any time, as in an ordinary telephone conversation. A typical two-frequency duplex assembly is shown in Fig. 3.

In the ordinary two-frequency duplex system, the number of stations on a given channel is limited to two. A

multi-station duplex system is sometime used. In this system two transmitter units and two receiver units are provided in the carrier assembly at each station. A contactor unit is used to set up automatically a two-frequency duplex channel between any two of a number of stations on the system. This switching operation occurs when a call is initiated, and conditions are returned to normal at the end of the conversation; thus full duplex communication is provided in a multi-station system, using a total of only two frequency channels.

The problem of providing a continuous power supply for carrier communication equipment has been solved in the past by providing rectifier power supplies operating from normal a-c sources, with a unit consisting of an automatic transfer panel and a dynamotor or m-g set operating from station batteries for emergency supply. Modern carrier communication equipment eliminates the need for these devices and their attendant maintenance. For applications where complete continuity of service is essential, assemblies of every type are available for operation directly from station batteries, without intervening m-g sets or inverters.

Carrier Relaying Equipment

The first carrier relaying systems to receive widespread use were those based upon conventional distance-type relays, and hundreds of terminals of this type of equipment are in operation today. These systems, introduced in the middle thirties, are responsible for the fact that carrier relaying is today considered the ideal system of relay protection for important high-voltage transmission lines.

The greatest single advance in the distance-type carrier relaying system since its introduction was the recent development of the modified impedance-type relay. This relay uses phase angle as well as impedance as a means for distinguishing between load and fault currents on long, heavily-loaded lines, and it is relatively immune to operation on system swings which would cause undesired relay operations in the conventional distance-type system.

The distance-type carrier relaying system is a power-directional-comparison system, in which directions of flow power at the ends of a protected line are compared by the relays over the carrier channel. Power flow into a line section at both terminals indicates an internal fault, for which the relays trip their associated circuit breakers without time delay. Power flows out of a protected line section at one end during an external fault and directional elements in the relays at that point cause transmission of a blocking signal to prevent relays at the other end from tripping under such conditions.

An entirely different carrier relaying system, the phase-comparison system, was introduced approximately three years ago and has met with wide acceptance in the central station industry.

Fig. 1. Modern power-line carrier assembly for relaying, emergency communication, telemetering and sleet detection

This system eliminates previous objections to the complexity of carrier relaying systems, because it requires a single relay with only two moving parts for complete protection against all types of phase and ground faults. No sources of line potential are required for its operation, because it operates by comparison of current flow alone. The relay at each terminal contains a sequence filter, which converts the three-phase line currents to a single-phase voltage. These voltages are compared over the carrier channel. If, under fault conditions, current flows into the line section at one end and out at the other during a given half cycle, an external fault is indicated and no tripping occurs. However, if an internal fault exists, current will flow into the line section at both ends simultaneously, and the relays will trip their associated circuit breakers without intentional time delay.

The modern phase-comparison relaying system operates almost entirely electronically, using an electronic switching circuit. It is ideally suited for the purpose of speeding up fault-clearing time on existing lines where relays already installed can be left in place for back-up protection. Among its other advantages is the fact that it is immune to operation on out-of-step conditions.

Carrier Telemetering and Load Control Equipment

The modern trend toward system interconnection and the formation of large power pools has led to the necessity for constant interchange over long distances of information on tie-line and station loads. This information is often supplied to load controllers, which generate impulse to raise and lower governor settings so as to maintain system interchanges at predetermined levels.

The telemetering equipment used in long-distance telemetering systems is generally of the impulse type, in which the magnitude of the quantity being measured is translated into impulses. In

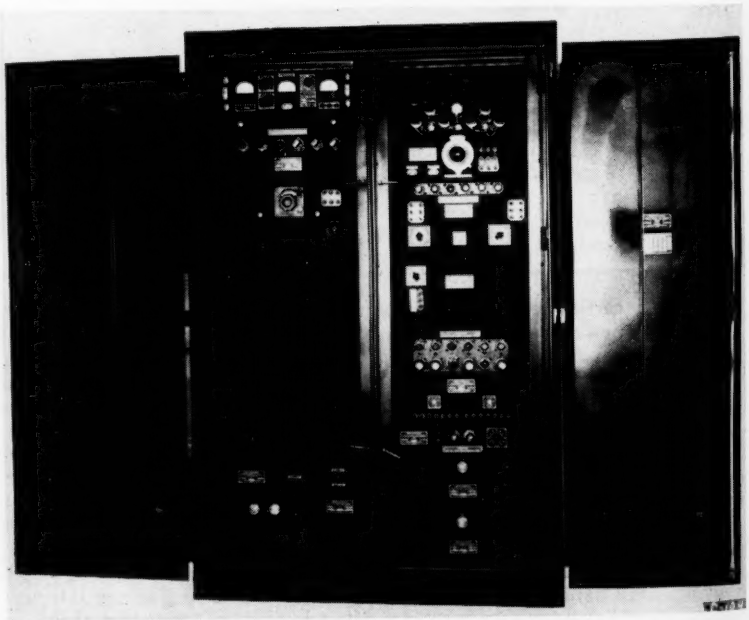


Fig. 2. Modern automatic-simplex power-line carrier communication assembly

Fig. 3. Modern two-frequency duplex carrier communication assembly

the high-rate impulse system, the rate or frequency of impulsing is varied in accordance with the telemetered quantity. In the impulse-duration system, the rate of impulsing is constant, and the duration of the individual impulses varies with the quantity.

Modern power-line carrier equipment often supplies the communication channels required for transmission of load control or telemetering impulses. The carrier assembly of Fig. 1 contains two, tone generating units, that modulate the carrier transmitter for transmission of two separate telemetering quantities. As many as ten such tone units, each generating a different audio frequency, can be used with a single carrier transmitter for transmission of as many individual sets of telemetering and load-control impulses on a single carrier frequency. Corresponding tone receiver units separate these impulses at the receiving end of the channel.

Carrier Supervisory Control Equipment

The labor shortages of the past few years have accentuated the interest of power system operators in unattended operation of stations. Supervisory control systems, operating over modern carrier channels, are providing many operators with means for supervising and controlling complete substations from a remote point. Supervisory control systems available today range from simple single-station systems capable of performing only a few functions at a single location, to extensive multi-station systems by which virtually an entire power system can be controlled and continuously supervised from a central point.

Modern supervisory control systems combine compactness and speed with extreme reliability. The modern approach is to use a simple code of impulses of identical length, with an automatic check transmission from the selected point at each sequence of the operation of selecting and operating remote apparatus. Provision of the automatic check eliminates the need for long complicated codes, increases reliability, and speeds up point selection.

Modulation Systems

Until recently, the amplitude modulation system was used practically to the exclusion of other modulation systems in power-line carrier equipment in which voice or other complex intelligence at audio frequencies was to be transmitted. Two additional systems of modulation are being used in modern power-line carrier equipment. Both of these, the single sideband system and the frequency modulation system, were made available generally for power line carrier purposes within the past three years.

The frequency-modulation system is capable of providing large gains in signal-to-noise ratio where large frequency swings are permissible as in F-M broadcasting. The gains it can provide in power-line carrier work, however, are restricted by the limited space available in the carrier spectrum.

The advantages of the single sideband system for carrier purposes have been realized for many years, and in the early thirties a single sideband communication assembly was available commercially. At that time no simple system had been developed of generating single sideband signals at power-line carrier frequencies, and the equipment was complicated and expensive. It served to prove, however, that the single sidebrand system could provide communication over power lines where the attenuation or the noise level was too great for the conventional A-M system. In the single sideband system, one sideband and the carrier itself of an A-M wave are eliminated in a low-power stage of the transmitter. The full power of the transmitter is concentrated upon amplifying the one side-band, which contains all of the intelligence of the original signal. No power is expended in amplifying and transmitting the carrier wave, which remains unchanged during modulation periods and therefore contains none of the intelligence. The resulting signal occupies less than half the channel space required by an A-M signal, an important consideration to users whose carrier frequency spectrum is crowded. At the same time the single sideband system, largely as a result of its efficient use of the power capabilities of a given transmitter, provides gains in signal-to-noise ratio equivalent to those of an A-M transmitter of eight times the carrier power.

In the modern single sideband power-line carrier system, a simple method of directly generating the single sideband signal is used, and recourse to the complicated filters and double-modulation schemes previously used is unnecessary. Units of this system are coordinated with standard A-M units of the same line so that any A-M assembly can be supplied with a converter unit to provide single sideband suppressed-carrier operation. Alternatively, the conversion can be made in the field after installation of the A-M equipment.

Twenty-five years of development of power-line carrier equipment has resulted in the flexible lines of reliable and compact component units available today. It seems unlikely that the basic system of making up assemblies from standard rack-mounting units will be changed in the near future, but continual additions to the numbers of the component units themselves may be expected. These will include units designed for carrier frequencies above and below the present standard carrier band of 50 to 150 kilocycles, because it would be extremely difficult to accommodate in the present band the large number of expected future installations of carrier equipment.

It is probable that carrier relaying systems will be applied to more and more lines on which slower relays are being used at present. The simplified phase-comparison system is providing impetus in this direction. We may also expect to see this system of relaying applied to lower-voltage lines for which carrier relaying has not previously been considered economical.

Many utilities are planning extensive additions to their communication systems. Power-line carrier communication equipment is receiving favorable consideration in these plans. The modern automatic simplex system, for example, is eminently suited for system-wide communication setups between widely separated points. The two-frequency duplex system will continue to be applied for trunk circuits and other point-to-point services on systems where channel space is available.

In the telemetering, load control, and supervisory control fields, powerline carrier channels will be used even more widely than at present for transmission of the associated impulses, because such systems are being extended over greater and greater distances than ever before.

CHEMICAL ANALYSIS seems far removed from radar applications, but, nevertheless a spectroscope using radar waves has been developed. The microwaves are directed through the vapor of the substance to be analyzed thus setting in motion the molecules of the substance. When the frequency of vibration is in resonance with the microwaves, the waves are absorbed. Each substance has a characteristic pattern of absorption lines which can be seen on an oscilloscope screen for identification of the substance.

Mouth Organ Engineering—How It Reduces Fan and Duct Noises

By **JOHN CASSIE,** Research Engineer, Sturtevant Division, Westinghouse Electric Corp.

AMONG THE MANY types of problems which confront engineers is the very perplexing one of "vibrations." One branch of vibrations is "sound."

Generally, a sound that is excessive, offensive, persistent or startling is called a "noise." Yet some sounds, satisfying these descriptions, are often considered as sounds of a musical or a pleasant nature rather than as noises. For example, the persistent sounds of an airplane's engine or the motor in one's car are both music to the ear of the operator. The startling sound of a pistol shot ending a race or basketball game is a pleasant sound to the contestant who is ahead at that moment. Likewise, the kettledrums of an orchestra—these sounds are called music, not noise.

Sound is a Form of Energy

It is at once evident that the problem is one of relative values and surrounding circumstances. Sound is a form of energy and, as such, is convertible into other forms of energy. For example, given an ordinary empty living room in a newly-built home, the sound caused by the workmen, walking across the floor, bounces from hard wall to hard wall for a considerable length of time. As drapes are hung at the windows, tapestries put in place and overstuffed furniture moved in, the same sound energy may be put into the room by the men, yet the sounds fade out quickly. The sound energy causes vibrations of the fibers of the room furnishings and finally dissipates itself into a corresponding equivalent, but unnoticeable, amount of *heat* energy.

Thus soft, fluffy materials such as hairfelt or glass wool are used as sound absorbers. They afford many interstices in which the fibers can move to and fro in this transfer of sound energy into heat energy.

The present discussion deals with noises in and about duct systems through which air or gas flows, particularly when fans are connected to these systems. Here are some typical ways in which such noises may be produced.

Noises in Draft Systems

One European country decided to try a new departure in its navy. Axial-flow type fans were substituted for the more conventional centrifugals for forced draft aboard ship. In those bygone days, the required air pressure was a matter of only a few inches water gage, yet it is stated that, in connection with the axial-flow equipped vessel, "Standing on the dock to observe the ship's arrival, the observer first heard the fans, then saw the smoke from the stacks and finally saw the vessel approach over the horizon."

During World War II, however, axial

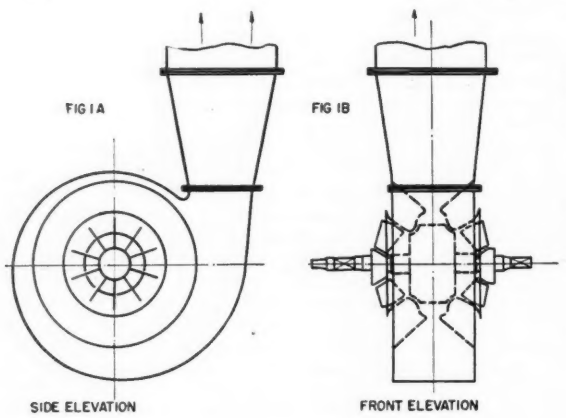
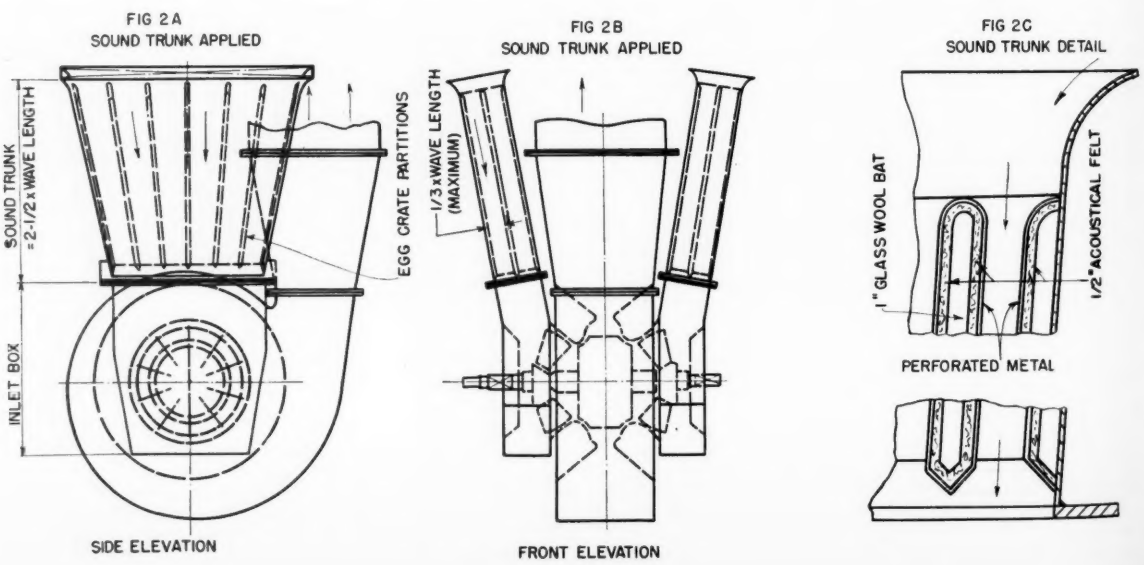


Fig. 1A and 1B. Front and side elevation views of fan as originally installed

Fig. 2A and 2B. Front and side elevation views of fan with sound trunk applied

Fig. 2C. Sound trunk detail



At last The Fan Doctor tells all . . . For years you've heard how he uses the mouth organ (harmonica) to help him in solving noise problems in fans and ducts . . . Here he shows just how he does it; not as a cure-all but as a very convenient and practical aid . . . If you hear a noise from the fan or duct, simply match it with a note on the harmonica . . . Then, by simple arithmetic, design a sound absorbing device of the right size and materials, put it in the right place—and reduce the noise 10 or 20 decibels . . . Always put sound absorber between source of noise and region of complaint . . . Mouth organ engineering will tell you if problem can be solved simply, or if it is so complex as to require the sound expert's more scientific analysis

flow fans were greatly improved. Pressures for Navy forced draft were maintained at over 40 in. water gage and, with the aid of sound-absorbing devices installed between these fans and the space above-deck (from which the fans drew their air), the fan and duct noises were kept at unbelievably low intensities. This prevented the enemies' sound detecting equipment from recording the approach of our vessels until the enemies' ships were vulnerable to attack by ours.

In central station work, present-day mechanical draft fans are, in some cases, being called upon to develop close to 100 in. water gage. The noise problem is daily becoming more critical. The public demands that noises be prevented when possible or eliminated by absorption, if the state of the art affords a successful eliminator.

The muffler on a car's exhaust and the silencer on a gun barrel has its counterpart even in a central station in the form of a sound trunk. Such devices have been effectively employed in connection with mechanical draft systems, handling air and hot flue gases. In designing such an appliance it is necessary to know, among other things, the frequency of the note causing the complaint.

How You Can Measure Sound Frequency With the Harmonica

On the market are many instruments designed for measuring such frequencies. In this connection, considerable skill is required in using such instruments and in interpreting the readings. Often such instruments are not readily available. Yet engineers faced with a noise problem can frequently solve it in a satisfactory manner, and inexpensively, by the aid of the methods explained below. And besides, one does not have to have the "perfect pitch" of Mozart to determine the pitch of the offending noise.

The notes of musical instruments correspond to the number of vibrations per second of musical instrument strings or reeds. As will be seen from Fig. 7, a standard piano keyboard covers a range of frequencies of, roughly 30 to 4200 cycles per second. In connection with mechanical draft fans, such a wide frequency range is seldom encountered on noise problems. Further, the piano is even more cumbersome than the commercial frequency analyzers to be transported to a noisy installation. The violin, also, has a rather wide frequency range (196 to 2092 per second). This instrument is lighter than the piano, but must be tuned and requires skill on the part of the user.

Fortunately, there is an instrument, the chromatic harmonica, commonly known as the mouth organ, of range sufficient to cover most frequencies encountered in power plant work, yet it is inexpensive, very light (weighing only a few ounces) and very small (see Fig. 7). As will be seen in the Cross Index Table, the range is from 131 to 2349 cycles per second, extending from the 28th to the 78th notes on the standard piano keyboard.* No musical ability is needed. Its use consists in matching the trouble-giving note on an installation with a particular note on the mouth organ.

On this instrument are an upper and lower set of holes. Blowing in a hole causes one note to result; drawing from this same hole results in a different note. A convenient sliding cover plate is moved to open or close either set of holes.

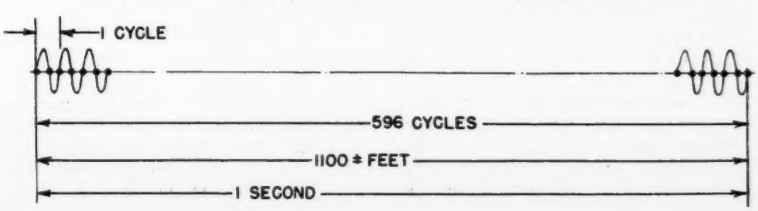
From the Cross Index Table it will be seen that, for example, if air is drawn from the hole numbered 9 the resulting note (corresponding to the 55th key on the piano) will have a frequency of 622 cycles per second. Blowing in the upper hole numbered 16, the resulting note (corresponding to the 76th key of the piano) will have a frequency of 2093 cycles per second.

A few actual case histories will best demonstrate how the frequencies, thus determined, can be used in ultimately

* Engineers who play the piano or know music will remember, of course, that the piano is a "tempered scale" instrument.—Ed.

Fig. 3. John Cassie demonstrates the use of his harmonica

Fig. 4. Relation of speed of sound to number of cycles per second



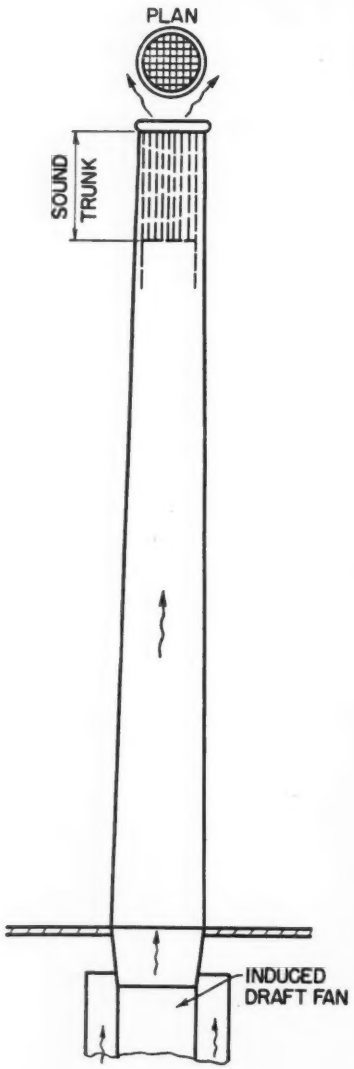


Fig. 5. Sound trunk installed in stack discharge

Table showing cross index of frequencies of piano keys and mouth organ holes

Cycles Per Second	Piano Key No.	MOUTH ORGAN Upper Holes Blow	Upper Holes Draw	Lower Holes Blow	Lower Holes Draw	Cycles Per Second	Piano Key No.	MOUTH ORGAN Upper Holes Blow	Upper Holes Draw	Lower Holes Blow	Lower Holes Draw
131	28	1	—	—	—	554	53	—	—	8–9	—
139	29	—	—	1	—	587	54	—	9	—	—
147	30	—	1	—	—	622	55	—	—	—	9
156	31	—	—	—	1	659	56	10	—	—	—
165	32	2	—	—	—	698	57	—	10	—	—
175	33	—	2	—	—	740	58	—	—	—	10
185	34	—	—	—	2	784	59	11	—	—	—
196	35	3	—	—	—	831	60	—	—	11	—
208	36	—	—	3	—	880	61	—	11	—	—
220	37	—	3	—	—	932	62	—	—	—	11
233	38	—	—	—	3	988	63	—	12	—	—
247	39	—	4	—	—	1047	64	12–13	—	—	—
262	40	4–5	—	—	—	1109	65	—	—	12–13	—
277	41	—	—	4–5	—	1175	66	—	—	13	—
294	42	—	5	—	—	1245	67	—	—	—	13
311	43	—	—	—	5	1319	68	14	—	—	—
330	44	6	—	—	—	1397	69	—	14	—	—
349	45	—	6	—	—	1480	70	—	—	—	14
370	46	—	—	—	6	1568	71	15	—	—	—
392	47	7	—	—	—	1661	72	—	—	15	—
415	48	—	—	7	—	1760	73	—	15	—	—
440	49	—	7	—	—	1865	74	—	—	—	15
466	50	—	—	—	7	1976	75	—	16	—	—
494	51	—	8	—	—	2093	76	16	—	—	—
523	52	8–9	—	—	—	2218	77	—	—	16	—
						2349	78	—	—	—	16

designing a sound absorber on a given job.

Figure 1-A shows the side elevation of the fan in a certain plant; Figure 1-B the front elevation. This fan is used for forced draft at high pressure. It had open inlets at the time of its installation but, since the specified pressure it was to develop was 70 in. water gage and the impeller tip speed was to be about 34000 fpm. (about 6½ miles per minute), provision was made, by double shaft extension, for later addition of inlet boxes and sound trunks, if and when found necessary.

Some time after installation it was decided that such trunks were desirable. As the impeller blades pass a given point of the fan casing in rapid succession, the air near the blade tips is subjected to a corresponding succession of compressions and rarefactions (or extensions) which constitute noise. Playing the notes on the mouth organ, from the lowest toward the highest, one note is found that closely matches or synchronizes with the pitch of the offending noise. In this case, it is found when air is drawn from hole number 9 of the upper row on the harmonica. This corresponds to the 54th key on the piano and 587 cycles per second.

The impeller speed is 3575 rpm. The number of blades on the impeller is 10. Sound travels approximately 1100 feet per second. The relation of these factors is illustrated in Fig. 4. Then (3575 ÷ 60) × 10 = 596 cycles per second.

Referring again to Fig. 3, it will be seen that a period of 1 second corresponds with 596 cycles and, since sound travels 1100 feet in this time, the wave length must be: 1100 ÷ 596 = 1.85 ft.

Experiment has shown that in a sound trunk, in the form of an egg crate (as in Fig. 2-A and 2-B), a length of 2½ times the wave length and not over ⅓ a wave length for the shorter side of the cell, results in a noise decrease of about 10 decibels. This is a considerable reduction, since the relation between decibels and the intensities is of a logarithmic nature.

In the above example the length (in the direction of air flow) of the sound trunk is: 1.85 ft × 2.5 = 4.6 ft.

The shorter side of the trunk cells is 1.85 ft × 3 = 0.62 ft maximum.

Details of materials and streamlining of cell partitions are shown in Figure 2-C. Since the installation of these sound trunks on this fan, it is possible to hold a conversation in an ordinary voice while standing beside either fan bearing.

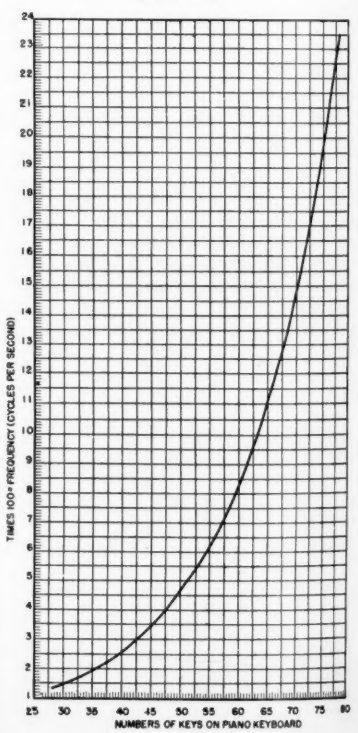
Note that the sound trunks are placed on the inlet side of the fan, between the source of the sound and the point of complaint.

Reducing a Noise in a Stack

Even when pressures are not unusually high (for mechanical draft), combinations of fan and connected duct or stack and surrounding acoustical conditions have been encountered which resulted in a single definite note. The note is confined within the stack until it reaches the stack discharge. The noise thus carried out to the surrounding neighborhood may be irritating and aggravating.

Such an actual case is shown in Fig. 5. Here the calculations, as explained above, are: (1184 fan rpm ÷ 60) × 12 fan blades = 237 cycles per second. Then 1100 fps ÷ 237 = 4.6 ft wave length. 4.6 ft × 2.5 = 11.5 ft length of trunk. Maximum dimension of the shorter side of cells is: 4.6 ft ÷ 3.1 = 1.5 ft. In this particular instance, the stack diameter was over 20 ft. To follow the above calculations would have resulted in a prohibitive number of cell

Fig. 6. Curve of frequency of numbers of piano keys



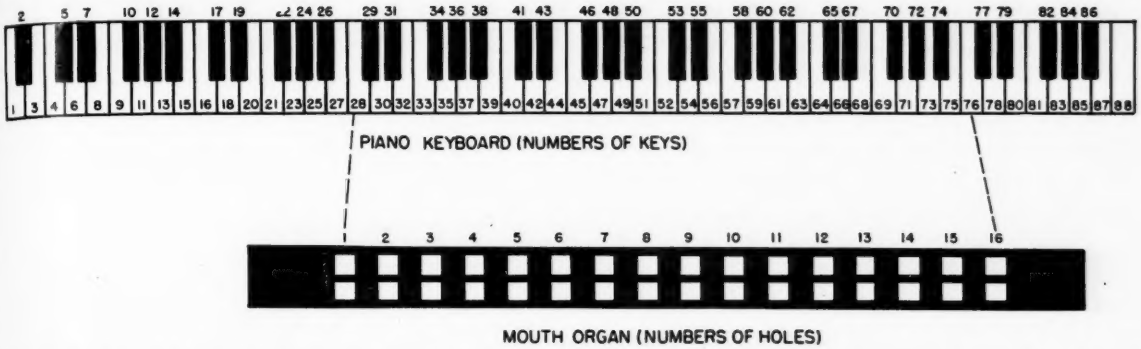


Fig. 7. Numbers of keys on piano keyboard and numbers of holes for mouth organ giving corresponding frequencies. Note: Harmonica and piano keyboard not to same scale. Harmonica actual size about 8 in. long

partitions. Also, in this case, it was desired to obtain a noise decrease greater than 10 decibels. Since the distance between cell partitions was increased, the length of the trunk was also increased and the actual length was made 45 ft. The decibel decrease was from over 100 to below 80.

Since the medium passing through the absorber is flue gas, the framework of the trunk is made of acid-and-heat-resisting steel. The absorbing material itself is glass cloth.

Note that in the case just described the sound trunk was placed on the *discharge* side of the fan but, as always, it is between the cause of the sound and the region of complaint.

The above-described method for investigating and remedying noise is, of course, not a cure-all but it may be of assistance in deciding whether the services of an expert are needed. Sounds can be very complex. When several objectionable noises occur simultaneously the chances are that a sound expert will eventually have to be called in. Even the real experts do not claim to have completely mastered the elusive subject of noise.

The Hot-Cold Pipe

Here is another one of the unexplainables which, while not in the same class with the flying disks because this one actually is visible, nevertheless has some of the Westinghouse research engineers puzzled

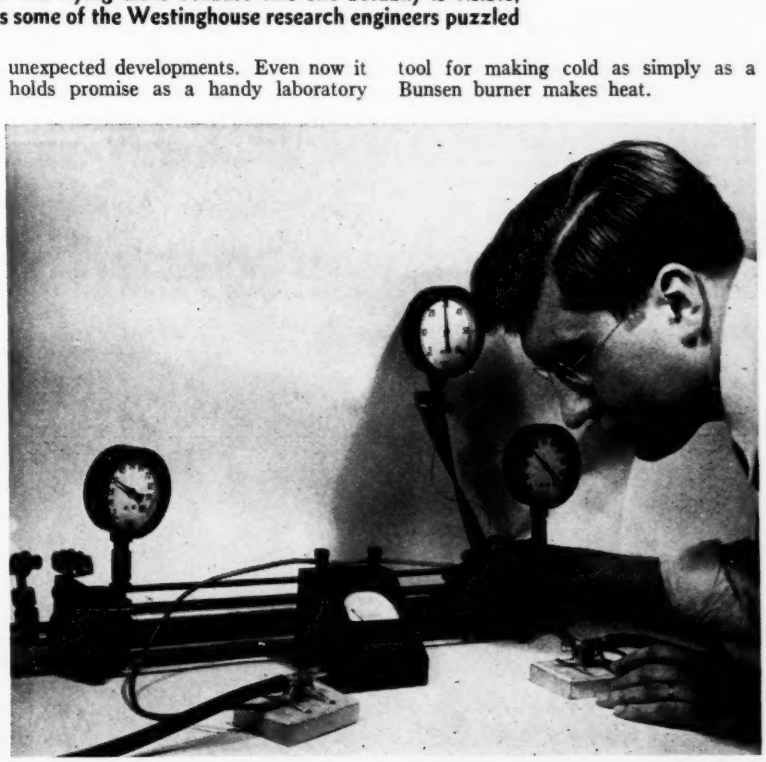
A "HOT-COLD PIPE" 15 in. long and 1 in. in diameter that converts ordinary compressed air into both hot and cold air without the aid of moving parts has been built by Westinghouse Research Engineers. As yet scientists have no explanation for the phenomenon though it is conjectured that the cause may be a frictional effect between gases moving at different velocities. To study the principle involved a working model has been made.

In operation compressed air is pumped into a nozzle at one end of the pipe. There it strikes the inner wall of the pipe tangential to the diameter and is converted into a whirlpool of spinning gases.

The air in the center becomes cold almost instantly while that on the periphery gets warm. The cold air is drawn off through a ¼-in. opening at the center of one end, while the warm air is tapped from the periphery.

With the original tube 5/10 in. in diameter, R. Holsch, its German inventor, claims to have produced simultaneous jets at 154 F and 10 F. The present model has purposely been constructed larger in diameter to expedite instrumentation for scientific study. For this reason it is reported as giving a temperature difference of only several degrees F.

Low efficiency rules out commercial application at this time, but like the "blue glow" in Edison's experimental electric light that led to his invention of the first electronic tube, it may lead to unexpected developments. Even now it holds promise as a handy laboratory tool for making cold as simply as a Bunsen burner makes heat.



The "hot-cold pipe" constructed at the Westinghouse Research Laboratories. Here engineer Warren Witzig—right hand on the incoming compressed air line—takes a reading. Hot or cold air may be tapped from either end of this model. However, as shown above, warm air is being drawn off at the left end while cold air is coming from the opposite end of the pipe. Thermocouples and galvanometer record temperature difference

A Modern Steel-Fabricated Motor

Welding, coupled with novel manufacturing techniques, has enabled the production of this new steel-fabricated motor . . . standard enclosures such as drip-proof and splash-proof are available . . . appearance is modern with clean lines and modern styling

By QUENTIN GRAHAM
Manager Ridgway, Pa. Division, Elliott Company

THE USE OF welding in the manufacture of electric motors and generators is not new although designing and manufacturing engineers are continually finding new ways of applying this very useful process. A line of moderate sized welded steel squirrel-cage motors recently developed illustrates one such application along with some novel manufacturing techniques. The sizes included in this line are from 150 hp to 1000 hp, 4 poles, with corresponding ratings for other numbers of poles.

Four Problems Paramount

Some of the problems presented to the designer in developing motors in these sizes are the following:

1. Standard enclosures such as drip proof, splash-proof, forced-ventilated, etc. must be available.
2. Both split-type sleeve bearings and ball or roller bearings are required.
3. A variety of core widths for each diameter as well as special mounting dimensions must be readily obtainable without excessive tool and fixture cost.
4. Appearance is important, with clean lines and modern styling desirable.

A unique feature is the bearing bracket or end shield design, which makes use of a solid flanged head as the basic shape with the bearing assembly as a separate insert. From the user's point of view this arrangement makes inspection and replacement of sleeve bearings relatively easy. Instead of having to unbolt and lift off a heavy half-bracket, the maintenance man simply removes a light bearing cap.

From the manufacturer's standpoint there are a number of alvantages. First, with the bearing housing separated from the supporting bracket, machining becomes much simpler than for conventional split brackets. The housing itself, which is the more intricate part of the structure, is handled on a turret-lathe, a small milling machine and a drill press.

The bracket, proper, starts as a flanged head, one of the present day available shapes, to which an edge-rolled ring is welded to form a bolting flange. Openings as required for ventilation and for insertion of the bearing housing are flame-cut in the head and an additional bearing support is welded in place. The resulting structure is rigid but light in weight.

The stator member contains some novel features. There is no frame in the usual sense, but instead a supporting structure is built around the punchings. A building mandrel is first set up and the punchings are stacked over slot keys and pressed between end plates by hydraulic pressure. The cross members, consisting of steel angles, are than welded to the end plates to lock the core in place. At two or more points the weld is carried across the back of the punchings to act as a key against circumferential movement.

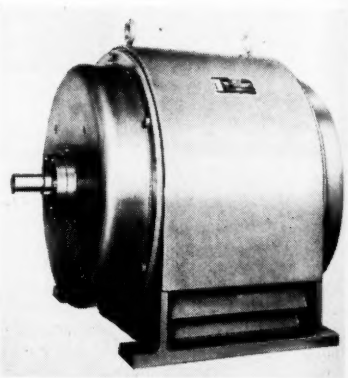


Fig. 1. This is one of the new squirrel-cage motors with ball bearings and splash-proof enclosure

Fig. 2—left. Detail parts of bracket and bearing construction for a sleeve-bearing, splash-proof motor. Fig. 3—right. This is a stator for squirrel-cage motor under construction. Punchings are built on a mandrel, pressed between heavy end plates and secured by angles welded to the end plates. The angles extend past the end plates and are also welded to the heavy frame side plates. A wrapper plate is added later

squirrel-cage
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The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

☆

DE RULER FOR MAK START DE TUR-BEEN

De firs ting is for comence de hoil pomp. When de pres-sur his Ho-K, den comence de tur-been. Hopen de trottle walve pretty slow, so de steam what his turn to water has come out de lille hole on de bottom. When de water aint no more plug de lille hole by shut de walve, han hopen de trottle some more when de tur-been has start for turn over (not de hole mashine, jus de rotor), den shut de trottle walve.

Now's de time for look for see hif you hear someting. Hif you don't hear someting when you look good, she is Ho-K, for make go more fast. Look de hoil pres-ure, look de water, look de steam, lock hefryting and hif she's Ho-K, took him to de top speed. Now hif she haint blow up, by now she his Ho-K for put de load. Try firs de hoxiter to see hif she work. Put you han hon de wire, de hodder han on de tur-been. Hif you harm his feel like you foots asleep she's Ho-K. Now hefry-ting his good for de load so shut de switch han let her go. Hall de time de hengineer mus walk round de tur-been han look for someting. Hif you no fine dats good. But look hanaway so's your boss tink you good hengineer.

P.S. No. 1 Don't forgit for to get sum wacuum.

P.S. No. 2 Run like hell hif she's blow up.

☆

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

XUM

Modern Thermometry in the Power Plant

The author points out that nearly all quantities and values in a power plant may be measured by temperature measuring devices . . . Review of early history of thermometry . . . Advantages of all-metal thermometer . . . Effect of overtemperature . . . Desirability of knowledge of fuel oil temperatures, when buying and when using

By A. H. LAMB, Chief, Relay & Thermometer Engineering Div., Weston Electrical Instrument Corp.

THE STEAM power plant is still the workhorse of industry and still leads in the economical and practical mass production of mechanical, electrical, and thermal energy and apparently will continue for a long time to come in spite of the inroads of the internal combustion engine, water power, wind power, yes, and even atomic power !

Coal, gas, oil, and water continue to be consumed in huge quantities by the steam plant and it, in turn, pours forth its pounds of steam, its Btu, and its horsepower.

And throughout the complicated processes involved in changing one form of energy to another and one type of power to the next, one important measurement predominates, the temperature. Some of the steps and substances involved in producing steam or power can be measured in pressure or in weight or in volume or in volts, but they all have a temperature ! And frequently only one correct or desirable temperature.

Actually the number of temperature measuring devices in use exceed all other measuring instruments combined. And thermometers exceed in number all other thermal measuring instruments.

The compass (lodestone) is the oldest navigational instrument and the thermometer is the oldest true industrial measuring instrument. We owe much to Messrs. Fahrenheit, Celsius, et. al. and a brief review of earlier thermometry might here be in order.

Review of Early Thermometry

Temperature may be defined as the condition of a body which determines the transfer of heat to or from other bodies. In the science of temperature measurement, thermometry, the most important requirement is the ability of the measuring device to indicate always the same values at the same temperatures. Galileo's thermometer or "thermoscope" (16th Century), while probably the earliest scientific approach to the problem of temperature measurement, was inadequate in this respect primarily because it used the effect of the expansion of air in a bulb upon a column of liquid in a tube and the variations of atmospheric pressure on the open column introduced errors which could not be compensated or controlled.

The development of the liquid-in-glass thermometers by Grand Duke Ferdinand of Tuscany in the middle of the 17th Century eliminated the errors caused by atmospheric pressure changes but the temperature indications were difficult to interpret because the scale was simply marked to represent thousandths of the bulb volume.

In 1701 Sir Isaac Newton created a scale in which the freezing point of water was 0 and body temperature was 12. In 1714 Gabriel Fahrenheit marked a mercury thermometer scale with 0 at the point reached in an ice-salt bath and with 12 degrees as blood temperature. Later, to obtain finer indication and more divisions, the scale was changed to 0-96 deg in which 0 was the salt-ice bath, 32 deg was the freezing point of pure water and 96 deg was (erroneously) body temperature. Subseqeuntly, the body temperature (or "blood heat") mark was corrected to 98.6 deg, and 212 deg was added at the boiling point of water. Newton's and Fahrenheit's contributions of fixed checking points of the freezing point of water, blood heat, and the boiling point of water thereafter replaced earlier "standards" such as "the temperature of a deep cave," the "coldest day," etc.

Still later in the 18th Century Reaumur laid out a scale of 0 to 80 R corresponding to 32 to 212 F and Celsius produced his centigrade scale in which 0 is the temperature of melting ice and 100 the temperature of boiling water.

In 1858 Lord Kelvin conceived a new scale starting at —273 C (absolute zero, at which it is assumed that all molecular motion ceases) and advancing in steps equal to the centigrade degree. Thus 0 deg K = —273 deg C, 273 deg K = 0 deg C and 373 deg K = 100 deg C.

Today the Fahrenheit scale is widely used in English speaking countries, with the centigrade scale used in the chemical and plastics industries and in scientific work. The Reaumur scale is used in the brewing industry. Some confusion occurs in certain complex industries where several types of thermometer scales are required or tables of formulas must be continuously referred to; however, in order to overcome this difficulty, thermometers may be obtained having two or more scales calibrated on the single thermometer dial.

The glass thermometer has served man well and its worth can never be questioned, although it has long been known to possess many undesirable characteristics. The glass stem and bulb are easily broken; the chips and mercury or other liquid can be troublesome if they escape into food; the emergent stem error can be considerable. Mercury freezes below —40 F and alcohol or other liquids which wet the stem must be used for such low temperatures. The mercury and the glass are not stable at high temperatures, and the liquid column tends to separate in shipment and in certain usages. Coupled with the foregoing, the etched stem types especially are somewhat difficult to read as is well recognized by

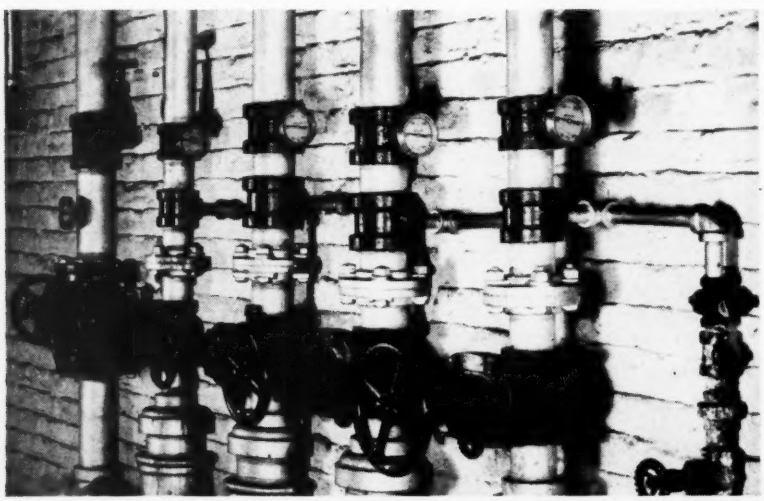


Fig. 1. Thermometers used to indicate temperature of water in hot water heating system return

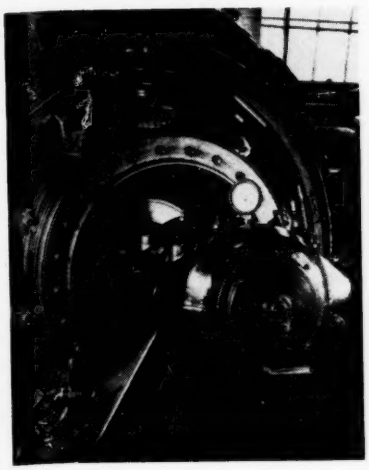


Fig. 2. This thermometer indicates the temperature of the bearing on a generator

those who use them, or by anyone who has had occasion to read a clinical fever thermometer.

Principles of Operation

Liquid-in-glass thermometers operate fundamentally on the difference in rates of expansion of liquid and glass under temperature changes. Mercury and alcohol have high coefficients of expansion, glass has a relatively low coefficient, often considered as zero. The higher rate of expansion of the liquid forces it up the thermometer stem as the temperature is raised.

Thermometers Everywhere

The modern power plant, be it steam or otherwise is studded with thermometers like an Easter ham with cloves. There is a thermometer at the feed end and exhaust of each unit of the plant and many thermometers in between.

The fuel has an ignition temperature, and/or a flash point; the intake air temperature is important; the fuel oil is preheated as is the feedwater, the stack gases are watched to be sure the temperature is not too low or too high.

Sometimes the temperature is read to determine just that, i.e.: the temperature. For instance, to check the temperature in a room or chamber or drier; at other times it is an indication of some other unit or condition, for example, the temperature of steam as an indication of the pressure, the stack temperature as an indication of combustion efficiency and excess air, the temperature of the steam in a throttling calorimeter to determine per cent moisture and the temperature of a bearing to detect the lack of lubrication and the temperature of a housing to determine internal overloads.

In these uses around a power plant, the thermometer must be rugged, and long lived, and able to take plenty of abuse. The atmosphere is frequently corrosive and moist and hot and dirty, there is vibration and there are accidental impacts and bumps. Cleaning and maintenance activities frequently damage delicate devices and a thermometer which goes down for the count if accidentally slapped once with a broom or wrench just isn't good enough. That's where an all-metal thermometer comes into its own.

While on the subject, let us review just what the all-metal thermometer has contributed to modern industry. The following enumeration lists the important points. 1. Errors eliminated—Certain errors inherent in the mercurial and other liquid-in-glass thermometers are non-existent in the all-metal type.

2. Accidental over-temperature causes no damage—On ranges below 250 F accidental overshooting up to 100 per cent will spin the pointer around and around but will not damage the all-metal thermometer in the least; 50 per cent over temperature is permissible up to 500 F and 10 per cent up to 750 F.

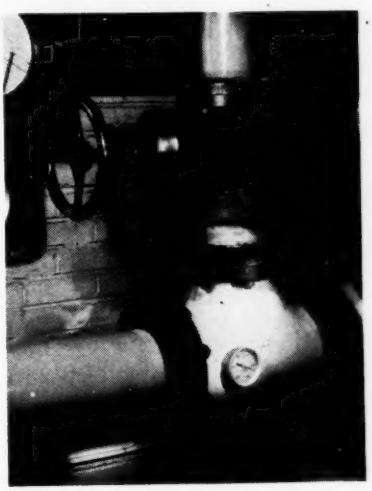


Fig. 3. Here the thermometer is employed in a processing steam line

3. Direct drive-through—In the all-metal type the bimetal element is bonded directly to the staff on which the pointer is mounted. No separation can take place.

4. Operation in any position—All-metal thermometers indicate accurately in any position, even face down, there being no liquid to be affected by gravity. In like manner centrifugal force in any direction has no detrimental effect and all-metal thermometers are frequently mounted on rotating kilns, paddle blades, rolls, pistons, etc., where they are read by ordinary light or stroboscopically, as required.

5. Can be read in the dark—Radium dials and pointers can be supplied and any luminescent or other special material may be applied as desired. In one particular application a toothpick-like tube of radioactive luminous material was bonded to the pointer and small button-like glass containers of luminous material were placed at various points on the scale.

6. Monograms and instructions imprinted on dial—The dial is large and roomy and it is frequently desirable to print safe and danger lines, or words, or flags, on the scale. Dials are printed in as many as four colors and carry much information in addition to the temperature scale.

7. Mechanical versatility—Since the all-metal thermometer is really mechanical by nature, rather than liquid, it offers wide mechanical flexibility. Thus the pointer can carry contacts, or a max-min hand, or drive small telemetering transmitters.

8. Pointed and gimlet ended stems—The stems may be pointed and carry various screw threads, gimlets, etc., for direct, easy entry into hard substances such as turnips, hams, cartons, and frozen food, all of which are checked at various times to determine their internal temperature.

Fuel Oil Temperature

We can now bring this article to a close by considering only one of the many detailed procedures in a power plant: the measurement of fuel oil temperature.

Economy and good operational practices indicate the desirability of continuous knowledge of fuel oil temperatures from the minute it is delivered until it is consumed in the flame.

Industrial fuel oils are usually delivered heated, the temperature sometimes running up to 150 F, whereas the gallon is based on 42 gallons to the barrel at 60 F. Since the fuel oil expands approximately 10 per cent for each 40 F increase in temperature, losses up to 20 per cent in the amount delivered might be encountered unless the delivery temperature is measured and due allowance made.

In the storage tank the oil should not be held at too high a temperature

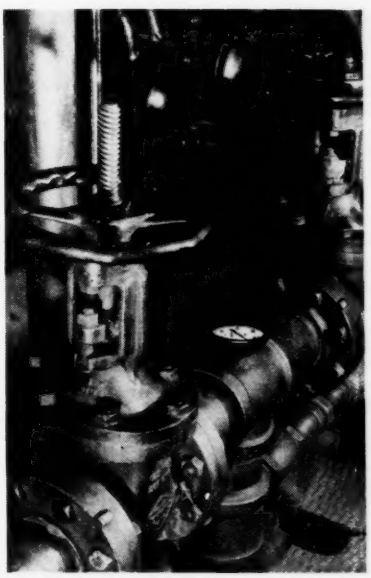


Fig. 4. Boiler feedwater temperature is indicated by this all-metal thermometer

especially if discharged by overhead suction as the pumping equipment cannot handle the thinner oil efficiently and also frequent overhauling would become necessary. Too hot oil also tends to carbonize and plug the heater and pipe lines with hard carbon.

Gas pockets or bubbles tend to form on both sides of the pump if the oil is overhot and these gas pockets explode at the burner tip causing popping, breathing, or pulsation effects in the flame in the fire box. If automatic drafts and other controls are used, they tend to bounce, fluctuate and hunt in unison with the unstable combustion pattern due to the gas pockets.

Mechanical burners require much hotter oil than steam atomizing burners, since the oil in the mechanical burner passes through extremely small orifices to break it up into small droplets so it moves into the flame as a fine mist, at pressures as high as 250 psi. If the oil is too cool the fire box may be full of "fireflys" instead of the desired ball of flame. If the oil is too hot and the boiler is running well loaded, there may be difficulty maintaining sufficient steam pressure due to lack of sufficient fuel being available for combustion. In mechanical burners, the fuel oil is usually preheated to 180 F to 250 F, the flash point becoming important enough to consider.

It is apparent therefore that the power plant in handling its fuel oil, as in many other phases of its varied operations, has many uses for thermometers, thermometers which like those in the oil lines must be rugged and reliable.

Controlling Weld Metal When Making Repairs

Many short cuts and labor saving kinks are possible through the use of welding carbon products such as paste, plate and rods . . . Thin metal sections and light parts may be backed up with carbon paste to prevent collapse of metal . . . Missing parts can be molded with carbon paste . . . How to make the molding tool

FOR THOSE difficult welding operations that depend upon accurate control of the welding puddle, don't overlook the possibilities offered by welding carbon products. Intelligent use of these products can often save a great deal of time and effort in preparing the job for welding and remove the need for subsequent machining, chipping, or grinding of the repaired part as well.

Uses of Welding Carbon Products

Carbon, in the form of paste, plates, and rods, has unlimited uses in welding, some of which are illustrated in Fig. 1. In one form or another, it can be used for molds, cores, and dams to restrict the flow of molten metal, or for protection of adjacent parts against excessive heating. It is a valuable aid in making vertical welds or repairing a break without dismantling the part to be welded.

From Linde *Tips*.

Carbon Paste

Most welding operators have undoubtedly felt the need for a fire-resisting compound that can be molded easily into any desired shape. Welding carbon paste meets these requirements.

When building up metal around threaded or irregularly shaped holes, much time and subsequent machining is saved simply by filling the opening

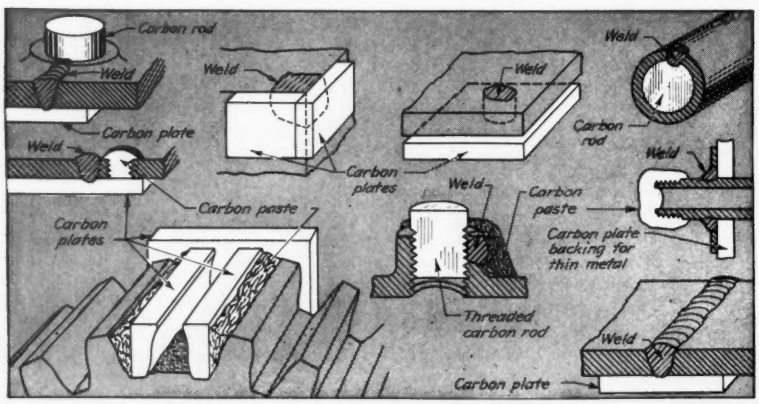


Fig. 1. Just a few of the typical uses for welding carbon rods, plates and paste

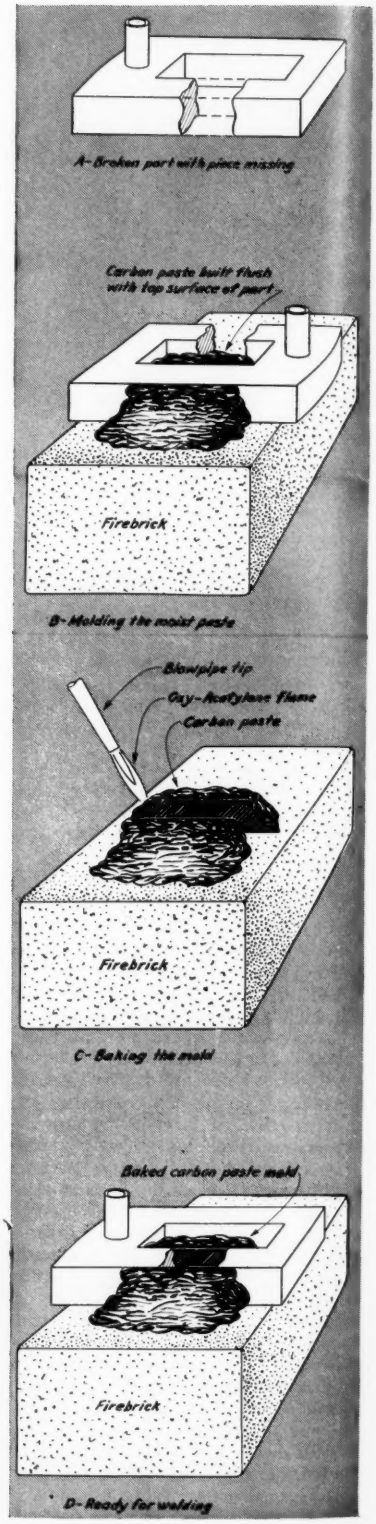


Fig. 2. A broken part with a piece missing (A) is easily restored with the aid of carbon paste. (B) The paste is molded around a similar sound section. (C) The moist mold is baked dry under the blowpipe flame. (D) The broken member is aligned in the mold ready for welding

with carbon paste before welding. Where it is necessary to use the blowpipe between or near machined surfaces, carbon paste provides a protective covering for such surfaces. Gear teeth and other finished surfaces are frequently protected in this manner.

Thin aluminum sections or light parts are commonly backed up with welding carbon paste to prevent collapse of the metal when heated. For aligning broken sections, either large or small, carbon paste eliminates the need for shimming. Once the work has been aligned on a cushion of carbon paste, the operator can preheat and weld without fear of parts sagging because of accidental displacement of shims while work is in progress. Simply place a few bricks, with daubs of paste upon them, at points that will insure uniform support of the parts to be welded. Then align the parts by pressing them into the carbon paste.

Missing Parts

Sometimes it is necessary to repair broken parts from which pieces are missing. Take the part shown in Fig. 2, for example. An experienced operator may rough out or rebuild this part to fairly close dimensions without the use of a mold or templet. But this type of work can be done better, quicker, and easier with the aid of carbon paste.

Preparation of a suitable mold takes only a few minutes. Place a sufficient quantity of carbon paste on a fire brick or welding carbon plate and mold it roughly to the shape and size required to completely surround the missing metal section. Then press a similar part in this case the unbroken section opposite the gap will do very nicely) into the paste and mold the paste flush with the top surface of the part. Remove the part and play the blowpipe flame over the paste until it becomes hard. When the carbon mold is baked, place the broken section in it as shown in Fig. 2D and proceed to weld. Control of the molten metal will now present no problem.

In like manner, molds for lugs, odd shapes, or pieces that have been broken off a casting are easily made with carbon paste at the point on the main casting where the break occurred. Weld metal is then flowed into the mold to form the desired shape. Building up a broken gear tooth is one of the most common applications of this technique.

A handy molding tool for work of this type is shown in Fig. 3. To make it, use a 10-in. length of ¼-in. diameter welding rod. Heat the ends of the rod under the blowpipe flame, bend, and form as shown in the illustration. Leave one end flat and the other pointed.

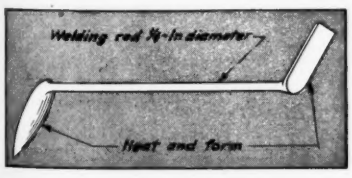
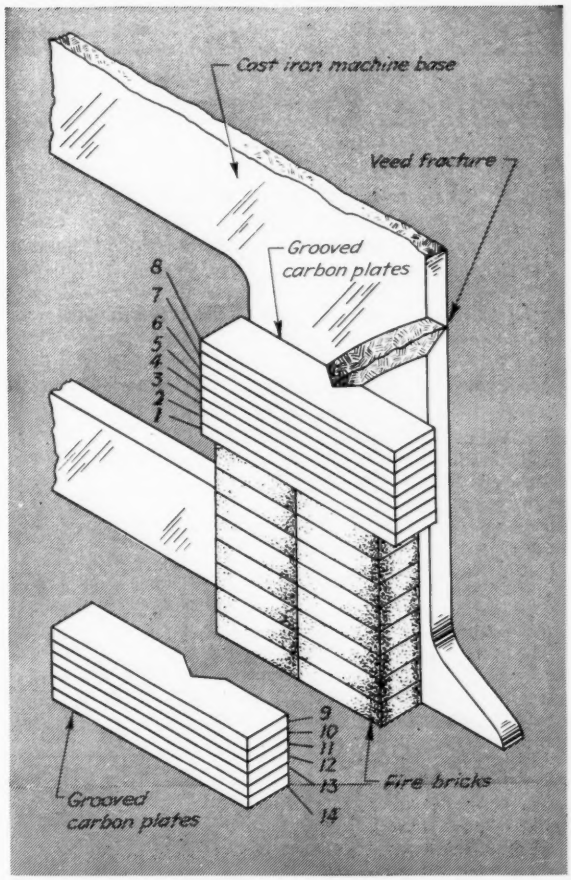


Fig. 3. This handy tool for molding carbon paste can be made by heating and forming the ends of 10-in. length of ¼-in. diameter welding rod

Fig. 4. Grooved carbon plates, progressively piled on top of one another as welding proceeds, control and shape the molten metal in making a vertical cast iron weld



Carbon Plates

Carbon plates are most widely used as backing-up material when welding thin plates or sections. When building up missing or broken parts they provide an excellent dam to prevent the molten metal from flowing beyond the immediate weld area. They are particularly useful in making forms for building up broken parts, such as teeth on gears or pinions, lugs, bosses, and broken pieces of castings. Placed underneath a weld, carbon plates preserve a smooth surface and remove the need for subsequent machining.

Making a Vertical Cast Iron Weld

The use of carbon plates for vertical cast iron welding makes it possible to complete even the heaviest welds in castings without dismantling them. Such welds can also be reinforced to any thickness desired by using a wider carbon plate than the weld and grooving out as much as necessary to obtain the thicker weld. Fig. 4 shows how this is done.

The grooved plates are placed, one at a time, against the casting. When the weld between the first plate and the casting is completed, the second grooved plate is placed on top of the first and the weld is continued as far as the top surface of the second plate. As each additional plate is set in place, the process is repeated until the entire weld is completed.

Another advantage is derived from the use of carbon products as forms for weld metal. When a cast iron weld is surrounded by welding carbon, the heat is held in the weld area to obtain an annealing effect, and the surface of the molten metal is protected from oxidation by the atmosphere.

Welding carbon plates are available in a great many standard sizes ranging from 11½ to 30 in. in length, from 5 to 15 in. in width, and from ⅛ to 2 in. in thickness. These plates can be cut easily with a hack saw to any desired size and can be shaped into practically any form with a rasp or abrasive wheel. Because they are mechanically strong and highly refractory, they do not shrink and will not easily burn, chip, or break. Under normal conditions they can be used repeatedly.

Welding Carbon Rods

Welding carbon rods are available in either 12- or 24-in. lengths and in sizes up to 3 in. in diameter. They are furnished with square ends but can be cut or shaped easily in the same manner as carbon plates. These rods are highly recommended as cores and fillers (see Fig. 1) to save redrilling holes that otherwise might be filled with metal during the welding process. Tapped holes can be given added protection by threading the carbon rod to fit.

Practical Applications of the Mollier Diagram—II

Characteristics Diagram of the Rankine Water Cycle . . . How to read the distribution of heat energy of the Rankine Cycle from the Mollier Diagram

By WALTER HEIDECKER

IN THE EARLY DAYS of steam power, most power plants operated upon what is called the "Rankine Cycle." The one condition that was characteristic of this cycle was that the feedwater entering the boiler was at the same temperature as the exhaust steam leaving the engine. It made little difference what disposition was made of the exhaust steam—it could be condensed and returned to the boiler, or it could be exhausted to the atmosphere.

The cycle itself was set up as a standard by which steam engine performance could be judged. Figure 1 is the characteristic diagram of a Rankine Cycle plotted on the Mollier diagram; the solid line being the ideal cycle and the dotted line indicating the actual circuit of the steam on this cycle. If an engine would operate without clearance, compression of the steam, or pressure losses, and if the steam were expanded adiabatically, the condition line of the steam passing through the cylinder would be the vertical cf Fig. 1.

Well-designed engines come fairly close to the ideal and this relationship between the ideal and the actual is expressed as engine efficiency—ce ÷ cf. The thermal efficiency may be expressed as the heat converted to mechanical energy divided by the heat added to the cycle—ce ÷ bc. The oldtimers said it in a different way. cf ÷ bc was called the Rankine Cycle efficiency, ce ÷ cf was called the Rankine Cycle ratio. Multiplying the Rankine Cycle efficiency by the Rankine Cycle ratio gave them thermal efficiency of the actual cycle. Presenting this mathematically—

$$\frac{cf}{bc} \times \frac{ce}{cf} = \frac{ce}{bc}.$$ The cf's cancel out leaving ce ÷ bc as the thermal efficiency of the actual cycle. They used indicators to make diagrams from which they calculated indicated horsepower. Dividing the actual horsepower (brake) by the indicated horsepower was their mechanical efficiency. They also plotted indicator diagrams of the ideal engine and from that, they calculated the heat available which corresponds to the cf on the Mollier diagram Fig. 1.

The practical value of Mollier's Diagram can be realized by plotting the diagram of the water cycle of a small power plant operating on a Rankine Cycle Fig. 2. The work of plotting the cycle using the information given in Fig. 2, has been done in Fig. 1

ABCF is the Rankine Cycle
ABCE is the Actual Cycle

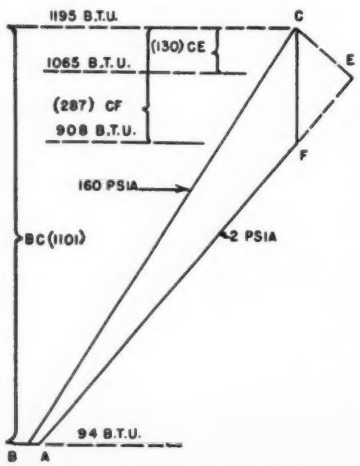


Fig. 1. The Characteristic Diagram of a Rankine Cycle plotted on a Mollier Diagram

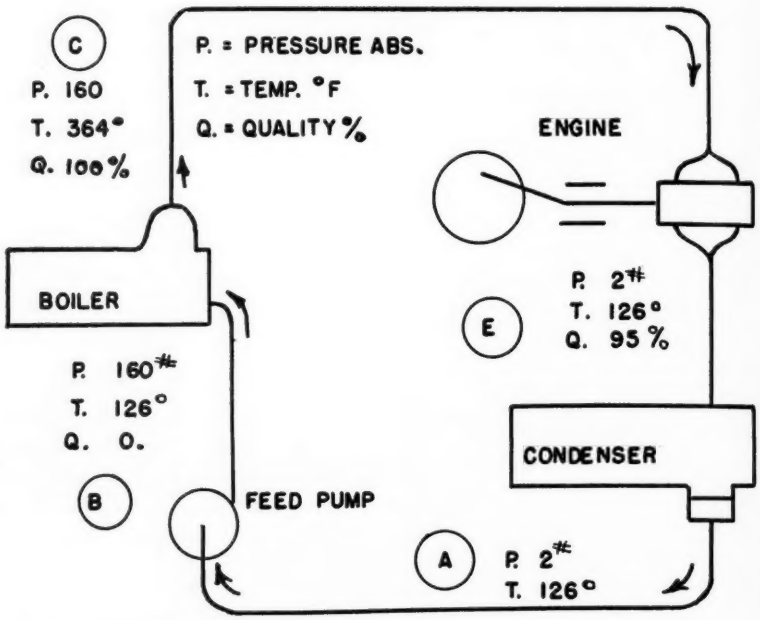


Fig. 2. Diagram of the water cycle of a small power plant operating on the Rankine cycle

Rankine Cycle efficiency = cf(287) ÷ bc(1101) = 26%
Actual Thermal Efficiency = ce(130) ÷ bc(1101) = 11.8%
Engine Efficiency = ce(130) ÷ cf(287) = 45%

The distribution of the heat energy of the Rankine Cycle can be read directly from Mollier's Diagram because all of the water (and water vapor) passes through each piece of equipment around the cycle. Modern power plants divide the flow of stream and water to the various pieces of equipment; as many as 15 different cycles returning water to the same boiler. To illustrate this distribution of heat energy, we may assume that the flow of heat units is comparable to a river; the width of the river and its branches being drawn proportional to the quantity of heat units (Btu) passing through the respective parts of the cycle.

Fig. 3 is a heat flow diagram of the power plant Fig. 2. The numerical values are calculated for the Btu in one pound of steam and are taken from Mollier's Diagram Fig. 1 to get the lb-hr multiply by the quantity of steam used in one hour. It is interesting to note in one hour.

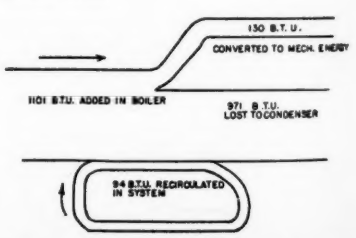


Fig. 3. Heat flow diagram of the power plant represented by Fig. 2

TUBE CLEANING

By "Fourteen"

THE FOLLOWING facts are well known to all tube cleaner operators, but as is true with all safety programs it requires constant reiteration to be impressive.

1. Don't be afraid of that noisy steel bumble bee, it is safe and efficient if handled with confidence and respect.

2. Check personally all screwed joints and couplings before opening the air to the motor. Hose couplings should receive special attention. Remember all joints and couplings should be tight—overtightening may lead to a cracked fitting which may prove fatal.

3. Compressed air is deadly when blown directly on the skin. Never direct a stream of air on your hand or body, be careful of the fellows around you.

4. Face-fitting goggles will keep your eyes free of scale, steel and dirt. Play safe; put on your goggles before entering an area where tube cleaners are being used.

5. Never inspect a tube from the opposite end until the tube cleaner has been removed and the safety plug stuck into the tube. (Safety plug is a handy jig tapered to stick into a tube, with a hole too small for motor to enter. The interior diameter is bright and fits a light source when desired).

6. Never start a motor unless the head or drill is securely engaged in the tube, and the motor or hose firmly held.

7. Stop the motor before withdrawing from a tube.

8. Close block valve to motor as well as quick opening valve when working on couplings, motors or heads.

9. Wear close-fitting clothes and keep sleeves down when using tube cleaners.

10. Respirators should be worn when dust is prevalent.

11. Make sure motor and tube size are correct.

12. If scale has a tendency to build-up on motor a hose lock should be used. This will prevent motor becoming a high speed projectile and shooting out of tube, endangering life and limb of operator.

13. Locate quick-acting valve so it is accessible from all positions to the tube cleaner operator.

14. Speed is essential in tube cleaning, but speed and efficiency can only be attained by a properly instructed and trained operator. A new operator must be shown tube cleaners are safe only if handled properly.

15. Safety and confidence are the prerequisites to good tube cleaning.

TIPS ON REPACKING THE STUFFING BOX

STUFFING BOX packing is causing more than 25 per cent of the maintenance problems of pump users, according to a recent survey.

Not all of those queried were specific as to the exact nature of the packing trouble but many complained that the maintenance men found it hard to pack pumps so that the packing would last for a reasonable length of time. A few of the engineers indicated that the packing used apparently was not of the material required for the liquids being handled. This was probably brought about by shifting the pumps from one service to another without changing the packing.

When repacking the stuffing box for the most satisfactory service this Company's engineers offer these suggestions:

1. Remove old packing from stuffing box taking care to withdraw the stuffing box lantern ring and the packing underneath and thoroughly clean the shaft, lantern and stuffing box.

2. For repacking use only the packing material originally recommended by the manufacturer, or use its equal for the specified service conditions. This is important since packings, like the pump parts, are designed for use in handling the various media encountered, ranging from clear water through acids, alkalis, etc. If there is any doubt as to the type of packing used, consult the manufacturer.

3. Cut rings from spirals, unless pack already is cut into rings, making ends square cut, so they just meet.

4. If new packing is metallic type each ring should be dipped in heavy oil and graphite before inserting in stuffing box. Install so that direction of rotation of shaft will not be against the edge of the foil wrap.

5. Install one ring at a time, tapping it into place, being sure joints are staggered.

6. Where a lantern ring is used install sufficient packing rings beneath it to assure locating the lantern opposite the grease or water seal connection.

7. Compress packing thoroughly, tightening gland entirely until packing feels solid in the box.

8. The gland follower should enter the stuffing box at least ¼ in. to prevent rocking of the gland. Clearance between shaft and gland should be checked with feelers to be sure shaft does not rub on gland.

9. Operate pumps and adjust the gland nuts so that gland is snug but not tight enough to bind shaft.

10. In water service conditions, the gland should leak a small amount of water at all times except when operating under a high suction lift and no fresh water connection is provided to the lantern ring.

The Yeomans Guard

"DON'T I FEEL WHAT?"

Diesel Engine Maintenance

Diesel Maintenance Experience of Oil Pipe Line Companies . . . Effect of Crude Oil in Diesels on the Lubricating Oil . . . Maintenance of proper cooling water temperature . . . Keeping accurate maintenance records

By FRANCIS A. WESTBROOK

AS DIESEL POWER is used extensively by oil pipe line companies at their pumping stations, many of them in isolated locations, their experience in developing maintenance procedures is of much practical value, and interest. This is particularly true as there is a lack of available data covering the conditions under which many of the diesel units must operate. The desirability of using crude oil as fuel because of its obvious economy has brought to light many facts and has resulted in numerous maintenance practices which are well worth knowing about. What is now being done along these lines can be most clearly explained by considering the solution of a few specific problems.

For example, one of the large oil companies has a main line pumping station which is equipped with 16 Diesel engines, each driving a crude oil pump. At this station 13 of these units are in continuous operation 24 hr per day, the remaining three being kept as spares to insure full operation when it is necessary to shut down some engines for servicing and repairs.

As this is considered a permanent installation the station was designed so that the crude oil handled by the pipe line could be used as Diesel fuel. Thus the crude oil is taken from the pipe line, centrifuged and stored in a day tank from which it is fed by gravity to the engines. Heat exchangers were installed in the engine cooling water system to obviate the use of radiators, although some of the units installed later when heat exchangers could not be obtained, have radiators.

Effect of Crude Oil on Lube Oil

When the station was first installed it was found that one of the principal maintenance problems to be contended with was the effect of using crude oil for Diesel fuel on the lubricating oil. That is, the use of crude oil for fuel resulted in contamination of the ordinary Diesel lubricating oils to such an extent that there was a serious increase in stuck piston rings and the deposit of carbon throughout the engines. This could not be overcome by changing the oil because the deposits remained in the engine, in spite of the fact that the lubricating oil was changed about every 200 hr of operation.

Various experiments were made in the effort to overcome these difficulties. Finally it was found that a by-pass type filter using Fuller's earth as the filtering medium would maintain the lubricating oil in satisfactory condition. As a result, it is now no longer necessary to change the lubricating oil from one engine overhaul to the next. It is only necessary to add lubricating oil from time to time to maintain it at the proper level in the engine. The largest amount of oil to be added when Fuller's earth in the filter needs changing, at periods diminishing from three months to one month as the time for an overhaul comes closer.

This procedure has resulted in savings of approximately 50 per cent in lubricating oil, an important increase in the normal life of pistons and liners, greatly decreased deposits of carbon throughout the engine and savings in lost time due to shut-downs of each unit for changing lubricating oil.

It was also found by experience that, because of using crude oil for Diesel fuel, a more rigid servicing system for spray nozzles was necessary than that recommended when refined fuel oil is used. The present practice in this respect at the Diesel-powered pumping station under consideration is to replace every spray nozzle in every engine once a week. The nozzles which are removed are cleaned and checked to make sure that there is no drip when the valve is closed.

When it is found that a nozzle is in such condition that it cannot be repaired to the company's satisfaction with the equipment which it has available, it is sent to the manufacturer's service station for complete overhauling. In this way the incidence of trouble is anticipated and shut-downs due to spray nozzle failures are reduced to a very low minimum.

Maintaining Proper Cooling Water Temperature

The cooling system as installed at this pumping station has provided control so far as the temperature of the water at each engine is concerned. There has been no trouble in maintaining the temperatures within the limits specified by the Diesel engine manufacturer. However, certain special measures had to be taken to secure these results.

Originally the make-up water for the cooling system was furnished by a well. This water was first treated by a softening outfit which, although it took care of the lime present, did not remove the iron also in the water. This iron formed deposits in the cylinder heads, causing considerable difficulty from heated engines and cracked heads. Several different measures were tried in the effort to eliminate this trouble but none of them proved to be satisfactory.

As only make-up water in comparatively small quantities is needed it was decided to by-pass the use of well water entirely and to install an underground tank filled with rain water collected from the roofs of station. Since this was done there has been no trouble with the cooling system and cracked heads have been reduced to an absolute minimum.

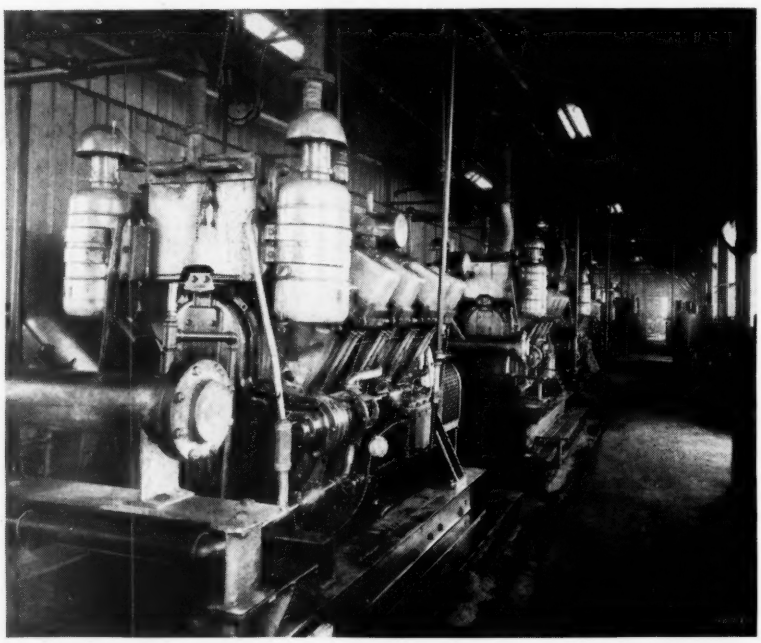


Fig. 1. View in an oil pumping station with 14 Diesel powered units consisting of Caterpillar engines and Gasco pumps, pumping 75,000 bbls per 24 hr. (Photo, courtesy, Caterpillar Tractor Co.)

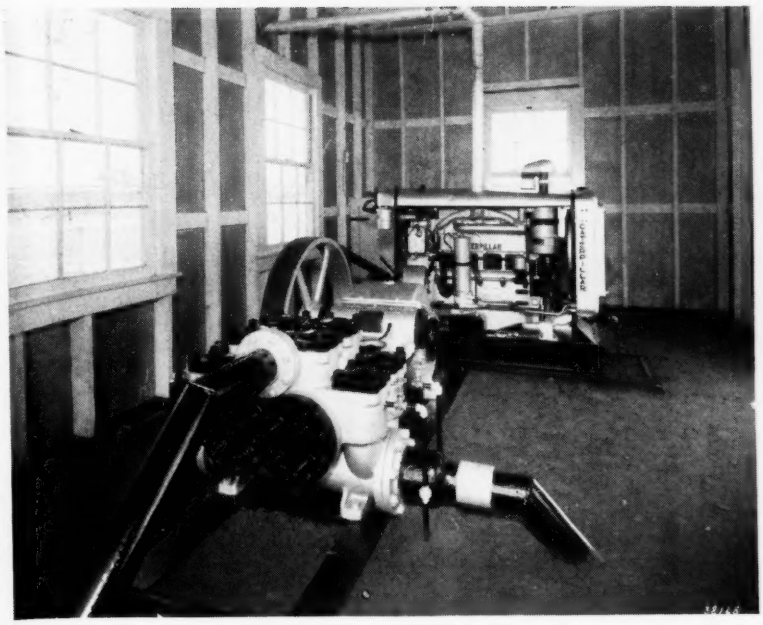


Fig. 2. View in an oil pumping station in Texas showing a Caterpillar Diesel engine driving a 3½ by 6 in. horizontal duplex Wheatly pipeline pump. (Photo, courtesy, Caterpillar Tractor Co.)

Before the corrective measures described were instituted the life of a set of pistons and liners was around 4000 to 5000 hr for the 130 hp Diesels and 6000 to 7000 for the 100 hp engines. After the corrective measures were put into effect the average life was increased from 2000 to 3000 hr for both sizes of engine. It was also found that connecting rod bearings and wrist pin bushings need replacement after 14,000 to 20,000 hr of operation.

After each piston and liner overhaul all valves are checked and reground, and worn out valves and guides are replaced. New seat inserts are installed when any valve seats become worn down into the head too far. When cracked heads are found they are generally repaired locally by cold welding. Starting engine repairs consist mostly of clutch and crankshaft and crankshaft bearing replacements. These overhauls are required after an average of from 10,000 to 12,000 hr of service. Very little trouble is experienced with the remaining parts of the engine, except minor replacements at the time of complete overhauls.

Records are kept for each engine, showing the hours of operation and every bit of maintenance work that is put on it. Consequently if any trouble develops there is pretty good evidence as to what is causing it. In the event that the engine has approached an overhaul period it is generally completely overhauled, instead of trying to tear it down in position and fixing the specific trouble. When it is necessary for an engine to be completely overhauled it is removed from its foundation and taken to a shop especially equipped for such work.

At other stations with four or more permanently installed Diesel pumping units radiator cooling is employed. By-pass type oil filters with Fuller's Earth are installed, as well as equipment for centrifuging the crude oil to prepare it for fuel. In smaller stations radiator cooling and by-pass filters are employed but refined fuel oil is used.

Another large oil company, in reply to inquiries as to its maintenance practices for Diesel engines used for pumping, says that it is running quite a few on crude oil fuel, but that crude gives good engine performance only when centrifuged. This has been shown in cases in which it was not possible to centrifuge the crude oil where considerable trouble was experienced with the injection system on the fuel pumps and spray valves. The company says that small Diesels, with certain of its Southwest crudes, will operate successfully, but that many of the crudes, even if centrifuged, will not burn properly in the small high-speed Diesels. It has made it a rule to purchase fuel oil for those installations where good crude for fuel was not obtainable.

The effect of the quality of the crude oil is strikingly shown by the performance of two 200 hp Diesels. One of these was very successful because the supply of crude oil was suitable. The other engine, identical to the first, was tried on crude of an inferior quality and gave so much trouble that it was switched to fuel oil, after which its performance was very satisfactory.

According to the conclusions reached by this company, after years of experience, the use of crude oil as fuel for high-speed Diesels can be called a semi-failure. Manufacturers claim that it is better, of course, to use straight fuel oil, with which they give fine performance. It is felt, furthermore, that fuel oil gives much more reliable service than crudes for large, heavy duty engines, although there are cases of very successful operation where crude has been properly prepared for use as fuel. It is to be borne in mind that many, if not most, crudes nowadays are not as sweet as they were eight or ten years ago.

H. P. Condensate Return Increases WallBoard Production

Use of high pressure condensate return system in plasterboard not only increases production but effects a fuel saving of some $5600 per year. Production of plasterboard in this factory has been increased ten per cent

By RALPH J. LUNDRIGAN Cochrane Corporation, Philadelphia, Pa.

IN THE PRODUCTION of gypsum plasterboard, high and uniform drying temperatures are required to maintain profitable production without excessive ejections. Uniform heat is a "must" with the plasterboard drying tunnels as this machine is made up of eight decks or conveyors (see Fig. 1). It is most important that the temperature be the same throughout the entire eight decks in order that all of the plasterboard be of the same strength.

To insure high coil temperatures in the blast heaters of the plasterboard drier at one particular plant of this type, a 5-hp Cochrane C-B high pressure condensate return system was installed in April 1946. Plasterboard is produced at an average rate of 10,000 sq ft per hr. The plant operates 24 hours a day, six days a week. Production for April 10, 1946, was 276,000 sq ft. The C-B System was installed for the purpose of returning condensate from the coil-drying system of the plasterboard drying machine which was for-

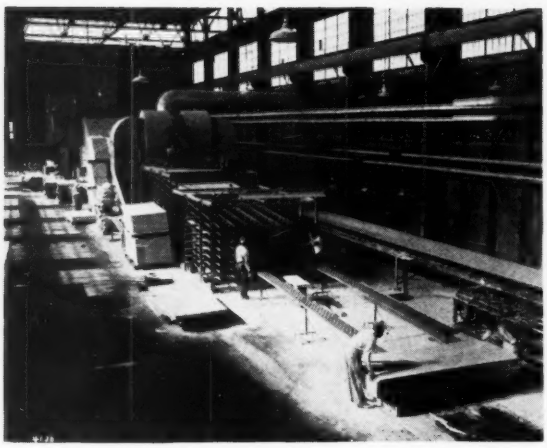


Fig. 1. General view of plasterboard drying machine

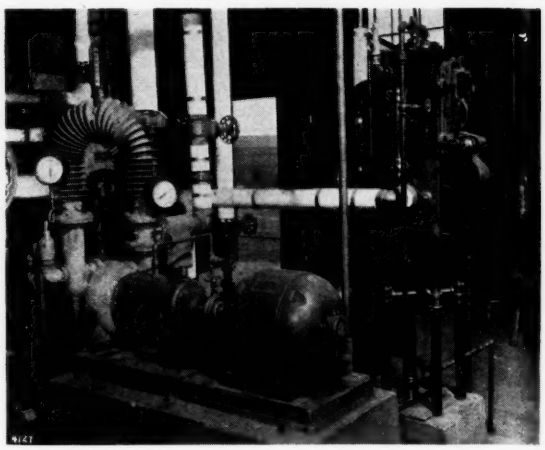


Fig. 2. Motor driven high pressure condensate return pump and thermofin loop. Cochrane open heater for makeup and low pressure condensate at right

merly done only by the pressure within the coils. Ordinary feed pumps are not capable of handling the mixture of air and hot condensate. The condensate at close to vaporization temperature tends to flash and bind the pump.

Principle of Operation

In the Cochrane C-B high pressure condensate return system a specially designed centrifugal pump draws water from the thermofin priming loop and discharges it as a high velocity jet through the jet pump nozzle (see Fig. 3). This jet strikes the returned hot condensate and induces condensate flow through the Venturi-shaped mixing tube and into the thermo-fin priming loop. The additional volume of condensate introduced into the constantly filled loop results in the discharge of an equal volume through the air separator to the boiler.

The hot condensate and entrained air are drawn rapidly and positively from the heating coils by the jet pump. Air is eliminated from the circuit by passing through the air separator and the condensate is returned to the boiler without appreciable pressure drop at maximum temperature (360 F) and pressure (140 psi). Thus, the circuit from boiler, through equipment, and back to boiler is completed in a closed system without substantial drop in temperature. Performance of the unit is verified by the pressure gage on the inlet together with the pressure gage and thermometer on the outlet.

Fuel Saving $5600 Per Year

Since the installation of the C-B condensate return system it has been noted that there is a 10 per cent decrease in the amount of fuel used. This is accredited directly to the C-B Unit. This savings in fuel amounts to approximately 1½ gallons of oil per thousand feet of plasterboard produced—at 5 cents a gallon, that is $18.00 per day, or approximately $5600.00 for a 312-day operating year. In addition the C-B system has helped to increase the production rate another 10 per cent.

Heat Balance

With blast heaters operating at 150 psi this condensate leaves the heating coils at about 140 psi which corresponds to 361 F (see Fig. 4). Assuming a typical heating load as 10,000 lb per hr the loss of steam in flashing from 361 F to 212 F in an open heater would amount to 1600 lb per hr at the established rate of 16 per cent for this pressure differential.

Thus 1600 lb of steam is saved each hour. This balanced against 75 cents worth of fuel saved each hour (1½ gal of 5 cents per 1000 ft of plasterboard with operations at 10,000 square ft per hour) indicates that steam is generated at the very economical rate of 27 cents per 1000 lb.

Summary

The Cochrane C-B System has helped to produce more uniform heat. Uniform heat is important in plasterboard drying in order that the entire sheet of plasterboard will have the same strength at all points. Previous to the C-B system installation uniform heat was troublesome. The condensate would lay within the heating coils and the live steam could not reach every point within the drying system. This meant that the entire production line must be slowed down in order that the finished plasterboard would come out

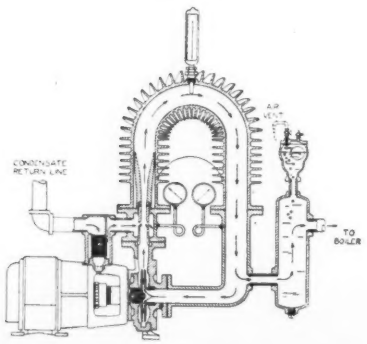


Fig. 3. Cross section of high pressure condensate return pump and thermofin priming loop

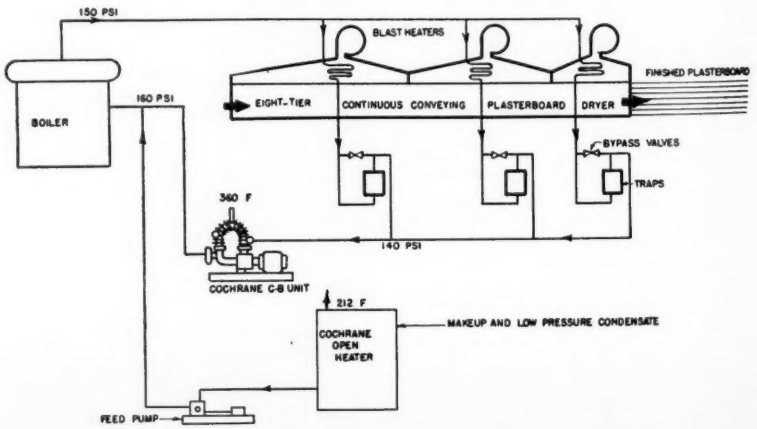


Fig. 4. Flow diagram showing location of high pressure condensate return pump

of the machine completely dry. With the installing of the high-pressure condensate return unit this condensate was instantly and continuously eliminated and a higher more uniform temperature was obtained which meant that the machine could be stepped up and a higher plasterboard production rate obtained.

The three advantages of high-pressure condensate return in our plant are:

1. Higher drying temperature for plasterboard sheets.
2. More uniform heating of blaster heater coils.
3. Fuel saving from higher temperature return.

LETTERS AND COMMENTS

BY-PASS VALVES

By N. T. Pef

SINCE in connection with any kind of control valve, a by-pass is generally used, there should be a demand for a special valve that is particularly suited for applications requiring a by-pass.

Such a valve is shown in Fig. 1 and consists of a body with three ports. The valve has two disks or one disk with a seat on both sides, and there are two seats on the body of the valve. In all other details, it is the same as the conventional valve.

Figure 2 shows the pipe of the usual by-pass arrangement which requires three valves beside the control valve. Figure 3 shows a by-pass layout using the special by-pass valve described above. As will be seen, only two valves are needed for this by-pass layout instead of three.

Normally the special by-pass valve will be in the open position toward the control valve but by running the disk down against the lower seat the control valve can be taken out of service.

The advantages of using this valve are as follows:

1. The initial cost will be less since one valve will be saved.
2. The operation is simplified. There will be only one valve to close or open instead of two and there will be no interruption of flow in changing from automatic to hand operation.

This type of valve also could be used in connection with flowmeters where it can function as the equalizing valve. This is shown in Fig. 4. Here also one valve is eliminated since only two valves are needed instead of three.

But the principal gain in using this valve with flowmeters is from the operating advantage. The manipulation of valves on flowmeters is of the greatest importance and they have to be opened and closed in a prescribed sequence. If the equalizing valve is open when the other two valves are open, or if it is closed when either one or both of the others are closed, injury to the meter may result or accuracy may be affected.

But with this type of valve it will not be possible to open or shut the valves in the wrong sequence. When the meter is in service, the disk seat is against the lower body seat and when the valve is against the top seat, the meter is out of service and the equalizing valve coincidentally opens.

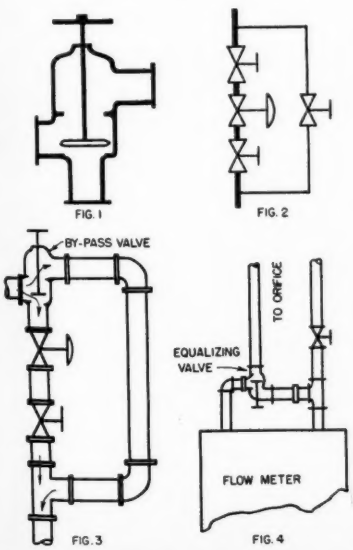


Fig. 1-4. See accompanying text for suggestions made by Mr. Pef for the use of this bypass valve

Mr. Pef's suggestion was passed on to a number of manufacturers of valves for their comments or criticisms. Most of them declined to comment on or discuss the matter but the following letters indicate how three of the principal valve manufacturers feel about it.—*Editor.*

• • •

IN ANSWER to your letter of May 16th . . . we have studied over the offer submitted to you by N. T. Pef.

The offer seems to have considerable merit to it from a mechanical viewpoint and no doubt would simplify the piping arrangements such as those described by Mr. Pef. The drawback however, is that he is suggesting the manufacture of a special item to replace items of standard design. Since the volume of this item would be small as compared to the item replaced, it is doubtful if any economy would result.

Standard valves are made in quite large volume and are tooled for low cost production. Whenever design deviates from these so-called standard designs, it requires much slower and more costly methods of fabrication, resulting in high unit costs. Only in those cases where the resulting advantages in operation offset increased costs will a special item be justified.

HOWARD G. DOSTER
Vice Pres. and Chief Engr.
The Ohio Injector Company

• • •

IN REPLY to your letter of May 16th . . . enclosing print showing new type of by-pass valve, we have examined the specification and drawing and wish to comment as follows:

Mr. Pef states that the advantages of this valve would be in using one valve for two purposes which would cost less than using the two valves. It has been our experience that the two valves used in the ordinary by-pass, which the proposed valve is supposed to replace, would be of standard construction namely a gate valve and a globe valve which in our opinion would be less expensive than the special valve proposed.

It is true that the operation with the special valve would be simplified in that the operator would be required to manipulate only the one valve. On the other hand, this special valve would have only the two positions and according to our interpretation when placed in either of these positions, one direction of flow would be completely closed and the other direction completely open. This is somewhat contrary to the by-pass layout in that the by-pass valve is ordinarily of the globe type which can be throttled and in this way the amount of fluid passing through the by-pass can be controlled by hand regulation. In other words, by-passes are frequently placed around regulating valve, automatic control valve, etc. with the view that when these special valves are inoperative or taken out of service for repairs, maintenance, etc., the line can be temporarily operated by means of the hand control by-pass globe valve.

It is probable that the special valve indicated on this sketch may have some uses other than those described although there are available two and three-way valves which do perform very much the same function as this special valve.

C. G. GRABE
Chief Engineer
National Valve & Mfg. Company

• • •

FROM OUR experiences, we find that the almost universal practice for the arrangement of piping for a regulating valve with by-pass is to use two valves around the pressure regulator and by-passing the assembly with a throttling valve for manual control in the event of failure of the regulator or during its interruption of service for repairs as shown by Fig. 2.

By-pass valves are always of considerably smaller size than the main line valve when used for steam and are of standard design. They are readily available and when repair parts are required, they are procurable almost everywhere at any time, whereas with the applica-

tion of the double-acting, double-seated valve, Fig. 3, it is special and is, therefore, considerably more costly, is not available on the market and the parts of which would be more costly and not easily procurable.

A double-seated valve would play havoc with a system during the course of travel of the disc, an undesirable condition which would not be possible where an additional valve is used which is the common practice. In this double-seated valve, reseating or regrinding of the seats would be extremely difficult as well as the assembly of the disc on to the spindle. The diameter of the disc would have to be smaller than the nominal size in order to be inserted through the inlet port and it can, therefore, be readily seen that to do any maintenance work with the seats or discs in a valve of this kind, it would have to be removed from the line and operations of this kind would be a considerably costly procedure.

We are simply giving you our point of view from our practical experiences based on valve design and their application and trust you will accept our explanation as being practical and not critical.

FREDERICK C. ERNST
Chief Engineer
Jenkins Bros.

ENGINEERS IN PUBLIC AND CIVIL AFFAIRS

DURING THE past few years, you have published many articles urging engineers to participate more fully in public life and civil affairs in general. A fine policy, indeed, and it is hoped that your ideas have fallen upon fertile ground.

What puzzles this writer, however, is just how the engineer will make his weight felt in alien fields, when in so many instances his worth in his own line is not recognized by business men, and other professionals.

This sorry fact was recently brought very forcibly to the attention of the author.

A group of scientists, busily engaged in planning a new venture, approached this writer with the proposition that he become chief engineer of the project.

On the surface, at least, the new position was an engineer's dream. Offering, as it did, the opportunity to design certain ponds, dams, channels, pumping stations, etc., with a considerable amount of liberty, and, as an extracurricular activity, the opportunity to do lab work in microbiology, water purification and the study of marine growth, the entire plane appeared most engaging.

With some fifteen years service with one employer, and the way to professional and financial success thoroughly blocked by office politics and nepotism, the author was ripe for a change. The prospective associates were vehement and aggressive in urging the change. "Just the man we must have," was one of the mildest phrases. Salary was no question, apparently.

The writer was just at the point of saying "yes" when, out of the general conversation he caught the sentence, "We must have you. After all, we will have to know where we can put a wall plug." ! !

Gentlemen, after some twenty-five years of work and study, we are at last consulted as to the location of a wall plug ! ! No, we did not accept the offer. Not with a start like that.

W.A.

Editor's Note: WA's letter is timely because we hear a great deal these days about the increasing necessity for the engineer's participation in public life. The thought behind this insistence that the engineer engage in public and civil affairs is something like this: The engineer is logical in his thinking, he is exact; ergo, he can solve all our social problems. Many engineers believe this. At a recent engineering meeting at which the writer was present, a well-known engineer read an 8000 word paper the entire substance of which was merely, that the engineer should engage in social and political affairs. It could have been said in a single paragraph.

Actually, engineers are little more capable of solving our social and economic problems than are our politicians and social workers. Engineering has to do with methods and materials—it utilizes the laws of mathematics, physics, chemistry; it deals with exact knowledge in so far as possible. Politics and sociology at the present time are anything but exact—they are not sciences even though they are often referred to as sciences. Even if there were many engineers willing to engage in politics, they would not do a very much better job than we are getting today from our political friends, maybe not as good a job. Politicians understand the minds and behavior of people and have more patience with people than engineers.

We hear much about the great cultural lag that exists between scientific knowledge and that which is known to mankind in general. Because of the great advance in scientific knowledge and the fact that many people attribute the evils of the modern world to this advance, some propose, ostrich like, to put a temporary stop to scientific research so that the sociological sciences could catch up. These people seem to think that mankind has up until now developed physics, chemistry, and engineering by preference, and that it could today take up psychology and sociology if it wanted to. This is not the way it works. Physics and chemistry have developed ahead of the other sciences because they are simpler. There is a definite order in which sciences have developed in the past and are likely to develop in the future.

This idea was put forth by the French philosopher, Auguste Comte almost a century ago and while it has not won much support, it throws a good deal of light on our present day troubles. There is no room here to discuss this idea in detail but anyone interested in it should read Philippe Le Corbeiller's article, "Stars, Proteins, and Nations" in the December 1946 issue of the Atlantic Monthly for in this article he discusses it at length.

There is a definite evolutionary pattern in the development of human knowledge. It runs something like this: Mathematics, Physics, Chemistry, Biology, Psychology, and Sociology. As Le Corbeiller points out, this classification actually fulfills the required conditions. Mathematics can be and often is presented without any reference to the material world. Physics (including its mother science, Astronomy) makes use of mathematics, but we are careful to eliminate from a physical experiment any chemical transformation. Chemistry uses heat and electricity, but on principle precludes the intervention of living organisms. Biology makes use of physics and chemistry; phychology presupposes living individuals; and sociology deals with these individuals acting as members of a group. If we run down the list, the successive sciences become more complicated, but more interesting to the average man, and more essential to his daily life; if we go through the list backwards, the sciences become simpler in subject but at the cost of becoming more and more abstract.

Thus it is obvious that advances in psychology and sociology depend upon preliminary advances in mathematics, physics, chemistry, biology, etc. As more and more is learned about these beginning sciences, more progress can be expected in psychology and sociology. As time goes on, and with further advances in the earlier sciences, mathematical formulae will begin to appear in texts on biology, psychology and sociology. A very little progress in the social sciences is equivalent to a great deal of progress in the physical sciences. Therefore, we must not be impatient with the slowness of progress in the social sciences. Contrary to what people think, we cannot solve sociological problems today by even the keenest reasoning. As Le Corbeiller points out, Reason can work only from secure premises, and the necessary premises to sociology, which are psychological, have not yet been obtained. To solve psychological and sociological problems, mankind will have to progress another few centuries. Therefore, if engineers want to make a contribution to human progress, they can do it best by sticking to their own field of endeavor —by evaluating and accumulating further knowledge which may prove of value to future psychologists and sociologists.

This does not imply that engineers should hold themselves rigidly aloof from questions of sociology and politics; they should participate in such activities as members of society but not with the idea that they, as engineers, know all the answers. They don't.

A.W.K.

PRACTICAL HINTS AND KINKS

MAKING A COAL SCREEN

By John F. Slavinsky

SINCE the beginning of the war years many an engineer had to change his mode of operations due to conditions beyond his control. In our case our regular supply of fuel was very uncertain. We had placed a standing order for 30 carloads per month of our favorite fuel and we were lucky to get 5 carloads. Therefore we had to locate other sources of supply.

Fortunately we contacted a very good supply of strip mine coal but we had to take run-of-mine; this, in turn, necessitated the building of an under-the-track hopper coal crusher. Also, we had to make provisions for coal storage other than the 1000 ton silos because during the months of January and February the stripping operations were uncertain.

We cleared off an area on our premises and during the months of September and October we were able to store about 5000 tons of mine run coal which ran in size any where from dust particles to 12-in. lumps. After storing this coal on a pile our next problem was to prevent fires. A fire in a pile of $8.00* per ton coal would have been very unpleasant.

A tractor with a bulldozer attached was hired and after leveling off the pile we had the operator run back and forth over it to pack it down as solidly as possible. During the months when coal shipments were bad we had to draw coal from the storage pile using a truck to carry it from the pile to the silo conveyor.

Of course the coal sizes were such that a lot of them would not go through the ram throat boxes into the fire. This was when we knew we must make a coal screen to be installed at the hopper. The illustration shows how the ends of the screen were bolted on to an iron clip which we installed on the sides of the hopper. Then we fixed up an ordinary pulley and chain to hoist the screen out of the way when it was not needed. The coal larry spout has a clearance of 16 in. above the screen. Lumps larger than 5 in. can not pass through the screen.

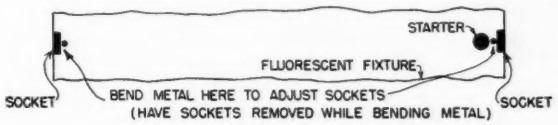
* This price includes the cost of handling the coal from car to pile.

Fig. 1. At far end of screen can be seen the iron clip to which the screen was bolted and the chains from the hoisting pulley

FLUORESCENT LAMP SOCKET SPACING

By Thomas Trail

ON SOME fluorescent lamp fixtures, the socket spacing may be altered slightly by bending the sheet metal to which the sockets are fastened up or down slightly, as shown in the accompanying sketch.

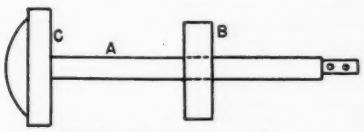


DRAWING OUT KEYS

By W. E. Warner

THE ACCOMPANYING sketch shows a device for drawing out keys, split pins, etc. It consists of a rod A, which is screwed at one end to receive a clamp to grip keys or split pins, the other end being fixed in a metal plate C.

Free to move up and down is a heavy



Device for drawing out keys

block B. In operation a clamp to grip the key or pin to be removed is fixed to the screwed end of A. Then by sliding B backwards and forwards on A and banging on the plate C, a strong pull is exerted on the key or pin and thereby released.

HOW TO FIND STACK GAS TEMPERATURE WITH AN ORDINARY THERMOMETER

THE FOLLOWING method of obtaining stack temperatures, when adequate instruments are not readily available, may be of interest to some engineers:

Place 12 lb of water in a glass vessel. Specific heat of water is 1.0. Obtain 2 lb of copper in cylindrical form. Specific heat of copper is 0.095. Measure the room temperature with an ordinary thermometer; let's say it is 60 F. That will be the initial temperature of water and copper.

Place the cylindrical shape of copper on a shovel, put it in the flue gas in the uptake of boiler keep it there until it is thoroughly heated.

Now drop the copper into the water and measure the rise in water temperature with the thermometer. Say it's 10 F rise, to 70 F. By the following simple calculation, the temperature of the stack gases can be determined with quite fair accuracy.

Example: 12 lb of water in glass vessel rose in temperature from 60 F to 70 F by the immersion of 2 lb of copper at stack temperature T deg F. $12 \times 1 \times (70 - 60) = 2 \times 0.095 \times (T - 70)$. Then $T = \left[\frac{12 \times 1 \times (70-60)}{2 \times 0.095}\right] + 70 = 701$ F stack temperature. By reversing above determination for a check, we find the specific heat of copper, using same quantities of water and copper, thus: $12 \times 1 \times (70 - 60) = 2 \times$ spec. heat copper $\times (701 - 70)$ so that spec. heat copper $= \frac{12 \times 1 \times (70-60)}{2 \times (701-70)} = 0.095$

Specific heat refers to sensible heat only.

R. H. NORTON

Rosita, Coah, Mexico

Questions And Answers

Question No. 391

HE WANTS STEEL-WORK DESIGN FOR RAILROAD TRACK SUPPORT OVER BUNKER

WILL Q & A readers show me how to calculate sizes of structural steel and method of fabrication to support coal cars over a coal bunker? The bunker desired is as shown in the sketch, which also shows suggested steel construction in dotted lines.

We have a track spur running alongside our boiler house, off the main railroad line, and the present coal bunker is at one side of the track and underground. Our boiler-house floor is also below grade, because of gravity return heating system for some 60,000 sq ft of radiation.

We wish to double our coal bunker capacity by extending the bunker out and under the track, as shown, at the same time casing the unloading problem by dumping coal into the bunker from any type of coal car the shippers might send us. This means supporting the coal cars over the bunker on steelwork, which in turn is supported on the concrete footings.

We plan to have the steel-work forming the roof of the addition at an angle as shown, for the top of the bunker is of no use after the angle of repose is attained when the coal is unloaded. It is estimated that the coal supply on hand will justify the purpose for which the bunker is used—approximately 16 cars of stoker coal.

Prairie du Chien, Wisc. W.N.S.

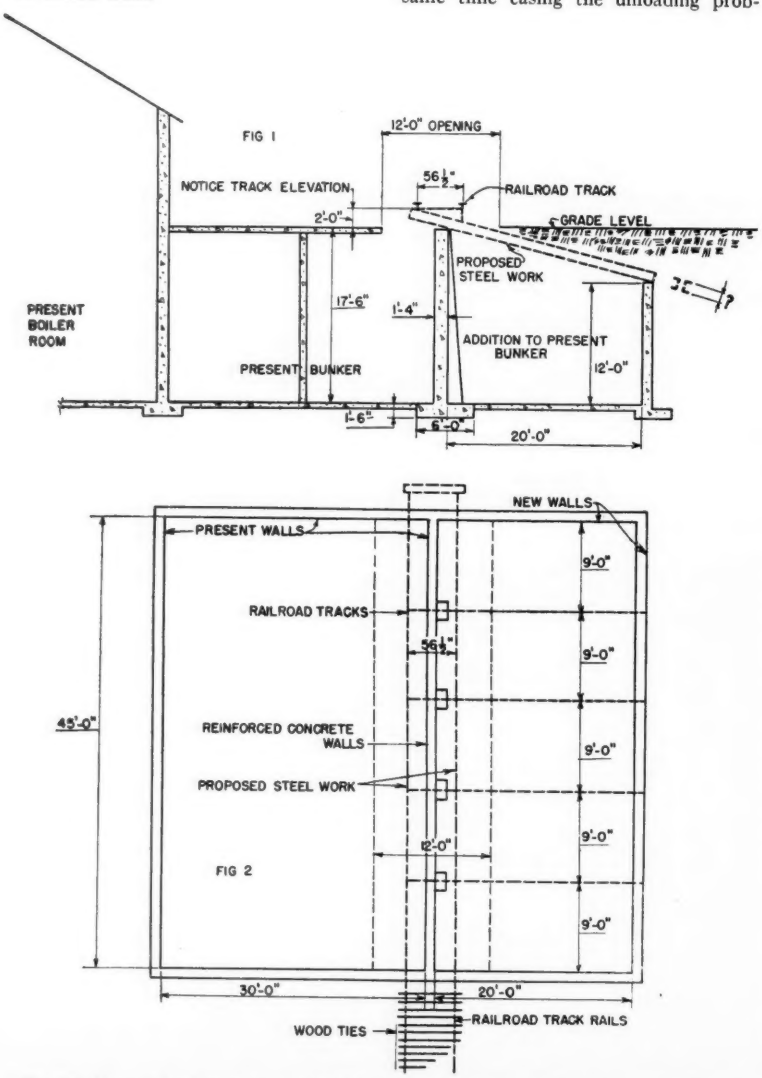


Fig. 1—Above. Cross-section of W.N.S.'s proposed underground coal bunker extension
Fig. 2—Below. Plan of W.N.S.'s proposed underground coal bunker extension

Question No. 392

WILL INCREASING PUMP SPEED GIVE NEEDED CAPACITY AND HEAD?

WE HAVE a single-stage centrifugal, plant service water pump, driven at 1150 rpm by a 30-hp motor, now delivering 235 gpm against 70 ft total head.

Although there is no name plate on the pump, our records indicate that originally it was rated at 500 gpm when operating at 1750 rpm. The pump seems to be in good mechanical condition, runs quietly, no gland or other leakage.

Now, we'd like to have this pump deliver 600 gpm against total head of 135 ft. Can we do this by replacing the present 1150-rpm motor with a 1750-rpm motor? If so, what horsepower will be required at 1750 rpm?

Would any changes be required in the discharge piping, which supplies general plant service water?

Chicago, Ill. M.K.

Question No. 393

HOW ARE COPPER OXIDE RECTIFIERS MADE?

KINDLY GIVE me some information about the materials used in copper oxide rectifiers and how such rectifiers are actually manufactured? There is plenty of information on the theory and application of copper oxide rectifiers in textbooks, papers before the AIEE, and publications of various manufacturers. But there is very little on the physical details of making them.

I understand that they are now being made to handle large amounts of power and being widely used, even in spite of the many recent developments in vacuum tube types of rectifiers. I also noted with much interest the description of the German contact type of rectifier on page 107, July issue.

Lansdowne, Pa. H.L.

Question No. 394

SCOTCH BOILER OPERATION

1. I HAVE an oil-fired Scotch marine type boiler that has been shut down and out of service for a considerable time—a year, at least, that I know of. Please give me detailed instructions for getting this boiler back in service, warming it up, getting steam up and putting it on the line.

2. How would you prepare such a boiler for the annual boiler inspection and what parts of the unit and auxiliary should you pay particular attention to just before the inspection?
Irvington, N.J. T.S.

Question No. 395

HOW PREPARE FUEL OIL TANK FOR RIVETING?

How WOULD you prepare a riveted fuel oil tank for driving a few rivets?
Irvington, N.J. T.S.

Answer No. 374

WHAT ARE DUTIES OF WATCH ENGINEER, FIREMAN, OILER?

Comments by McBeth

CONCERNING THE DUTIES of a watch engineer, here in Ohio we call them operators or just engineers. A watch engineer should be able to do any of the work under his supervision; such as instructing a new man on firing, oiling and treatment of water. In large utility plants, these duties are far removed from the turbine room and he cannot direct them as he must in smaller plants where the unit is more compact.

He must know all valves, pipe lines and location of every piece of equipment, so that in case of emergency he can get himself out of trouble in the shortest time. It all depends on the nature of the plant just what the duties are. Every engineer should be able to lay out a schedule on what he is supposed to do on watch. Having been through two tube failures and a generator burning out, I find it is a good plan to think of what you would do in case of trouble.

The engineer must have patience and a pleasing personality, for he takes men who are unfamiliar with the plant, instructs them and molds them into good operating men who know what to do and how to do it.

I believe an engineer should be able to direct or do himself such work as repairing boilers, stokers, pumps, engines, turbines and all other equipment in the power plant. He should be able to treat water for the boiler—take a sample and titrate it, know what changes to make. He should know combustion and firing and also know the different kinds of lubricants used. A great number of men attain the rank of engineer and do not have the opportunity of doing this work. Sometimes job qualifications, and other factors do not permit them to do it. The engineers' examinations here in Ohio cover all kinds of questions, among which are a number on repair of power house equipment.

I have held a First Engineers' license for a number of years. I started out firing a Scotch marine boiler and cleaned it out under the eagle eye of a one-striper. The Army and Navy have the duties for each kind of work; but we who have done our time there are glad to chuck that out of the window and lay out our own schedule.

Watch Fireman

1—Responsible for all operations during his shift, including reading of meters, gages and such reports; and for operating personnel.

2—Should be able to make minor repairs and adjustments to all power house equipment.

3—Should be able to operate the switchboard and watch the power load.

4—Must have a good working knowledge of all power house equipment.

5—Must be able to work with others; both willing and able to instruct others in all phases of power house operations which are under his supervision in the plant.

Fireman

1—He must be able to fire or control the adjustment of whatever type of fuel burning equipment is used, also be able to maintain the proper flow of air for good combustion.

2—Should know the location of all important valves and piping in the boiler room.

3—Must be able to instruct anyone under him such as the coal passer or assistant fireman in their duties.

4—Should be familiar with boiler feed pumps; and be able, in case of failure of one supply of feedwater, to start the other pump or whatever there is for auxiliary boiler feed.

In some plants he has all the equipment in one room; in large plants it is farther removed from his reach and in case of one pump failing the other starts automatically. In the small plants he might be by himself and must watch the fire, water, heaters, pumps, hydraulic pumps and all other equipment. As I have stated before, the fireman, like the engineer, should be familiar with all duties as soon as possible in the boiler room and be ready for any trouble which arises.

The Ohio State Law does place the responsibility of the plant or boiler room on the engineer or fireman. It does not state the duties of the man on watch, as plants vary in size and it would be hard to state the exact duties of the man on watch. Where they have job classifications, they have a list of duties drawn up for the engineer and fireman, as he is paid according to what he has to do.

I do not believe that any local union has any list for the man on watch for here again the State Law governs.

Oiler

1—Should have a general knowledge of machinery and its lubrication of same, know the different kinds and grades of oil and greases used.

2—Should be depended upon to keep the equipment clean and properly serviced.

3—Should have a good knowledge of power house equipment and be able to recognize improper performance of same.

4—Must be able to help the engineer in starting of turbines, engines or other auxiliaries.

As the oiler is under direct supervision of the engineer he is able to gain a wealth of knowledge on how the plant is run and can better himself in his position. He also has the tasks of wiping the pumps, engines, turbines, wherever grease and oil oozes out and some places that is plenty. He has some responsibility as some of the auxiliaries are away from the engine room or across the street. A good oiler will do all of his work without being prompted and in the meantime study to become an engineer.
Cincinnati, Ohio RAY MCBETH

Answer No. 375

CAN FURTHER ADJUSTMENTS BE MADE ON THIS ENGINE?

Too Much Compression, Late Release, Says White

DEALING with this question in the April issue, where three indicator cards have been submitted for analysis, the cards show too much compression, and a late release.

If necessary, a much longer cut-off could take place. Too much compression takes power, and too late a release steals power. Compression should be the least amount that will carry the engine over the dead centers quietly. The No. 3 card shows that in release the final pressure has not fallen to the back pressure until about 9 per cent of the return stroke has been completed.

It is a fair rule on this type of engine, that the compression and release take place at 5 per cent of the stroke finish, or 95 per cent of the stroke. With the exhaust valve wrist plate in its central position, both exhaust valve edges should be in line with the port edges. When the wristplate comes to the central position in operation, the exhaust eccentric high point or throw will be in the vertical position, either up or down, 90 deg from the horizontal, and the crankpin will be off the dead center to the extent that the crosshead indicates where compression and release takes place in the stroke. In this case, it should be 2 in. from the end of the stroke or dead center. Any movement of the eccentric will now move the wristplate off the central point, and one valve will close, and the other open more.

If the arrangement of the exhaust valve rods, with the wristplate at the middle of its travel and with the valve and port edges line-on-line, was disturbed by increasing the lap of the valves, then compression would take place earlier and release later. If the arrangement was not disturbed, but the eccentric was moved to bring compression earlier, then the valve closing for compression would have lapped to some extent, and the valve opening for release would have opened as much more as the other had lapped, bringing about earlier release. It is evident that the exhaust valves have too much lap.

Marks will be found on the engine to centralize wristplate, and also to show its proper swing on either side of

the center, when the reach rod, rocker arm, and eccentric rod are in relative adjustment. With the wristplate central, and held there, and the reach rod disconnected, and the valve bonnets removed from the outer ends of the valve chamber, the valve rods should be adjusted until the marks indicating the valve and port edges are line in line.

Reconnecting the reach rod, and removing anything that might have been used to hold the wristplate on center, the engine is turned in its running direction, until one valve comes to the edge-on-edge closing position. The point where compression starts may be observed on the crosshead, and how far it commences from the end of the stroke, which should be 2 in.

If this is not the case, then the eccentric must be moved until the desired result is obtained. Turn the engine to the opposite position, and check the result. Changes for equalization should be slight. Any large change required shows a mistake has been made.

The separate steam eccentric gives quicker initial motion and a much longer cut-off than is feasible with the single eccentric Corliss. In No. 3 card the cut-off takes place, on an average of the two sides of the card, at about 57 per cent of the stroke, probably the extreme of a single-eccentric Corliss. But it could just as readily have taken place at 87 per cent of the stroke in this engine, so more power is available.

With the steam wristplate in the center position, similar to the exhaust plate as explained above, and with the ends of the valves exposed and the valves hooked up, the marks on the valve and ports edges should show the valves just a little less than half open. With the steam wristplate in the central position, as with the exhaust eccentric, the steam eccentric position will be vertical or plumb to the horizontal, and will be halfway between its extreme movement back and forth. So if the hook was to close the valve, as well as open it, the valves would be about half open with the wrist plate central.

Securing the wristplate at center, adjust the valve rods on both valves until they are a shade less than half open —in other words, both have negative lap to the extent given. Removing any means taken to secure the wristplate during adjustment, and with the reach rod connected, turn the engine in the running direction, and check the lead. Move the eccentric until the proper lead is obtained, which should be $\frac{1}{32}$ or slightly better. Check on the other dead center. Slight adjustments should equalize matters. Any large adjustment would indicate a mistake in procedure.

The cut-off may be adjusted with the governor blocked in the running position until the cams will just make the hooks unlatch. They should also be adjusted to equalize the cut-off. Final adjustment may be made with the indicator while the engine is running.

Hammond, B.C. WM. S. WHITE

Answer No. 376

WHAT TESTS AND PROCEDURES WILL IMPROVE PRECIPITATOR OPERATION?

A PRECIPITATOR is used to condition water for his plant, said R.T.F., the water being drawn from the Delaware River, in which at each turn of the tide, waste products from other plants sweep back and forth across his intake.

He is using the jar test on raw water to determine the amounts of soda, alum and clay to use in the precipitator under these conditions. But he is not getting very good results and wants data on the jar test and how to use it and on the best way to operate this precipitator.

Here is some practical, specific help on the jar test by one who obviously has had experience with it.

Comment on Jar Test by Grant

THE JAR TEST is used to give a general idea as to dosage in water treatment in plant operation. However, it does not supplant the physical analysis of your water.

The jars used for samples should be of sufficient size to use 1 liter of sample water. And the agitation should be controlled so a duplication of plant mixing conditions are approximate.

The chemical solution used in jar tests is made by dissolving 17.14 grams of chemical in one liter of distilled water. By adding 1 ml (1 milliliter = 0.001 liter) of this solution to 1 liter of sample the equivalent dosage of 1 grain per gallon is obtained. In case you wish to convert gpg (grains per gallon) to parts per million multiply by 17.1.

The raw water samples are placed in the jars and stirring devices set in motion. Progressive volumes of chemical solution are added to each jar, covering the range of expected dosage. A graduated pipette is very useful at this stage. Agitate the chemical in the sample violently, follow by a period of gentle stirring. Observe the character of the floc and the rate at which it settles. Select the minimum dosage that gives the best floc and settling characteristics.

It would have been very beneficial if you had given the pH value of your raw water and the estimated retention time in the precipitator. From the trade waste you speak of, I take it for granted the raw water alkalinity is low.

As a suggestion try this method on your jar test. Make an alkalinity test on your raw water. Say it was 15 ppm. Jot this down. Allow a reserve alkalinity of 25 ppm. For each grain of alum used, multiply by 8 (because alum reduces the alkalinity 7.7 ppm). Then use this equation, assuming 2 grains per gallon of alum was used:

2	×	8	+	25	−	15	=	26 ppm
alum used		alum factor		reserve alk.		actual alk.		required soda dosage

If the alum isn't reacting properly, it may pass through your filters as residual alum. This can be checked by analysis of filter effluent and pH.

In general application, alum is considered as a slow coagulant and if the retention period in the precipitator isn't sufficient, or the agitator speed is too high, the floc formation may be broken up. A violent agitation is recommended during the mixing process but gentle water flows should be used during floc formation and during settling out periods. If no floc is visible in treated water before settling, the alkalinity is sufficient and more alum may be added. However, if the floc should be large flakes, too much alum is being used in relationship to the alkalinity. The water temperature also has a bearing on alum dosage, and slightly larger dosages may be needed in the winter months.

It may be worth your while to experiment with other coagulants such as sodium aluminate, ferric sulphate or ferric chloride. Chemical supply houses would be glad to send you enough material for this type of work.

Keep a good set of records during experimentation periods. Include the analysis of raw water, precipitator effluent and treated water, water temperature, chemicals used and operational data. This makes a good reference for future operation, saving labor and headaches.

From the meager data given, this is about the best I can "give out." However, if you care to send me the analytical results of your raw water, precipitator effluent, filter effluent and water temperature, also rpm of precipitator agitator, size and retention period, I would bend the elbow in an endeavor to be of further assistance.

Danville, Illinois JOHN A. GRANT

Answer No. 377

HOW MAKE FORCED DRAFT AIR FOLLOW FUEL FEED?

ON EACH OF his two 40,000-lb-per-hr boilers, an electrically operated combustion control operates to increase output from about 4000 or 5000 lb-per-hr to full output in about 10 seconds, to meet a process blower steam demand that comes on in that time. Forced draft control dampers in the burner windbox ducts are operated by the air flow regulator through electrical contacts, which actuate a small motor to drive the damper operating lever through gears and a crank wheel. Dampers are of the louver type, counterweighted and all equipped with ball bearings.

However, the dampers do not follow the rapid increase and decrease of fuel feed fast enough; some smoke is made and there is danger of loss of ignition. Is there any kind of mechanical device he could install between the constant-speed damper motor and damper lever, asked E.E., to make the dampers follow the fuel feed, without complete remodeling of the combustion control system.

Operate Dampers by Steam or Air Power Cylinder

IF E. E. desires to operate his dampers in only two positions, i.e., fully open or slightly open, he can get practically any desired speed of opening or closing in the following ways:

Eliminate the motor, gearing, crank

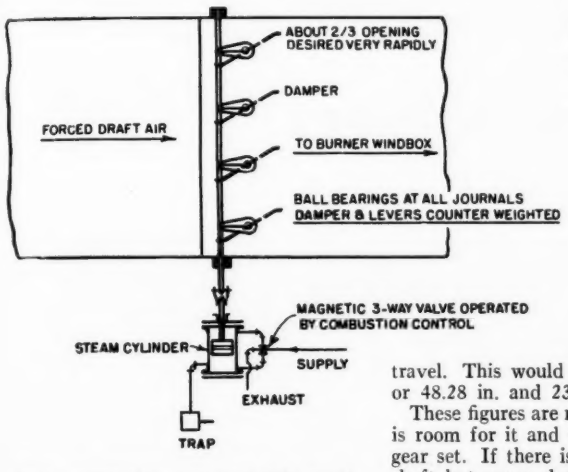


Diagram by Butcher showing how E.E.'s dampers could be operated by a steam or air power cylinder controlled by the air flow regulator

wheel, connecting rod and bell crank. Install a steam cylinder with a piston in it connected to the damper actuating rod, through a suitable linkage.

Control the steam supply with a magnetically-operated valve under the direction of the control impulse from the air regulator, using a relay if necessary. If a three-way valve is not readily obtainable, use two valves, one direct acting and the other reverse acting, installing the latter valve on the cylinder exhaust. Provide the steam cylinder with a drain trap and insulate thoroughly.

Compressed air may be used in place of steam, in which case no trap would be required. Cylinders may be single acting with counterweight for opposite action, or they may be double acting for fast action in closing as well as opening the dampers. An electric thrustor or solenoid may be used in place of the air or steam cylinder.

By installing needle valves on both the inlet and exhaust lines the rate of action may be controlled as desired.

The accompanying sketch shows the schematic layout.

Piney River, Va. · IRA A. BUTCHER

Use Direct Motor Drive

E. E. CAN accomplish the desired results on his forced draft damper by connecting his motor, through suitable gearing, to the damper shaft. If the motor has a speed of 1750 rpm, as is usually the case, and the damper speed will be ¼ turn or 90 deg in 10 seconds or $\frac{1}{40} = .025$ rps, since $1750 \div 60$ is 29, then the speed ratio is 29 to 0.025 or 1750 to 1.5.

Considering a worm gear set, set to the above ratio, and having 8 teeth to the inch or 1/16 in. teeth, then for every 29 turns of the worm (1 sec) 29 teeth will be moved on the main gear and in 10 seconds (¼ turn of the forced draft shaft) 290 teeth will be moved to open the damper to the wide open position. The size of the main gear will then be $(4 \times 290) \div (8 \div 3.1416)$ or 46.15 in. in diameter or 23.075 in. in radius. As you only need 290 teeth, then use ⅓ of a segment having $(4 \times 290) \div 3$ or 387 teeth. This allows for overtravel. This would be an arc of 387/8 or 48.28 in. and 23.075 radius.

These figures are not excessive if there is room for it and would save multiple gear set. If there is not room near the shaft but room elsewhere, then set the gear set somewhere else but in line with the shaft and use a reach rod connected to the rocker arm of the damper shaft and use the main gear as an eccentric, which would give the same results.

A much better but much more expensive arrangement would be to have a gear-motor set built to the above ratio, connecting the low speed side directly to the damper shaft by a flexible coupling. These sets are built by various manufacturers and are very efficient and compact.

Baltimore, Md. CHAS. W. PARKS

Answer No. 378

WHY DO DUPLEX PUMPS SLAM?

Constant Back Pressure Will Stop It

OUR FEEDWATER heater condition closely parallels that of J.R.H. and we have experienced the same trouble he complains of. In our opinion, the answer is to maintain a fairly constant back pressure. As he gets a temperature of 230 F, I should judge he probably has a back pressure of around 5 lb. A sudden reduction of this pressure causes "flashing" of this 230-deg water to steam, thus causing vapor lock in his pumps. A live steam connection through a reducing valve to maintain a constant back pressure I am quite will end his trouble. At least it has for us.

Mechanicville, N.Y. R. F. LEACH

Maintain Constant Heater Pressure Through a Reducing Valve

IN THE PRESENT case, we are not told whether the feedwater to the heater is all cold water or whether it contains condensate, nor do we know, of course, how this condensate, if any, reaches the feedwater heater, whether intermittently or continuously. It can be seen quite easily that these factors would influence the operation of the heater and should be taken into consideration when attempting a comprehensive solution.

Let us assume that the water reaches the heater at a temperature which varies gradually, if at all. From what J.R.H. tells us, its temperature must be relatively low. Going through the cycle of operation, let us start with the compressor running quite fast, thus producing a considerable amount of exhaust steam. This steam is sufficient to raise the temperature of the water in the heater to 225 to 230 F. A quick look at the steam tables shows that the pressure in the heater must be between 5 and 10 psig.

Now, if suddenly the compressor slows down, the amount of steam from exhaust going to the heater drops to a faction of what it was. Since the water going into the heatar does not diminish, an unbalance is the result. Cool water going into the heater now quickly condenses the steam in it, and a sudden drop in the pressure of the heater occurs. This internal heater pressure very likely falls to a few psi below atmosphere. The water in the bottom of the heater and in the pipe to the pump, still having a temperature of say 225 F, under this drop in pressure will partially flash to steam. This condition will be more pronounced at the pump inlet, since the pump piston will be trying to suck water into the cylinder and this will aggravate the temperature-pressure unbalance. Hence the vapor lock.

It will be easy to check the accuracy of this analysis by installing a vacuum-pressure gage at the pump inlet.

The solution, of course, is to maintain a constant balance between the temperature and pressure of the feedwater, without sudden fluctuations. This can best be accomplished by maintaining a constant steam pressure in the feedwater heater. Evidently the exhaust steam from the compressor is not always sufficient for the purpose, so additional steam should be piped to the heater through the reducing valve.

Paterson, N. J. FELIX M. GIORDANO

Slow Down Pump or Inject a Little Cold Suction Water

IN ANSWER to the question of JRH in the May issue, what happens is this: When the load goes off the compressor, the exhaust steam pressure in the feedwater heater drops, causing a partial vacuum, thereby causing the feedwater to flash into steam in the water until its temperature corresponds with the lower exhaust pressure. The exhaust pressure drop naturally reduces the suction head on the pump to become steam bound and consequently the pump starts slamming or running away.

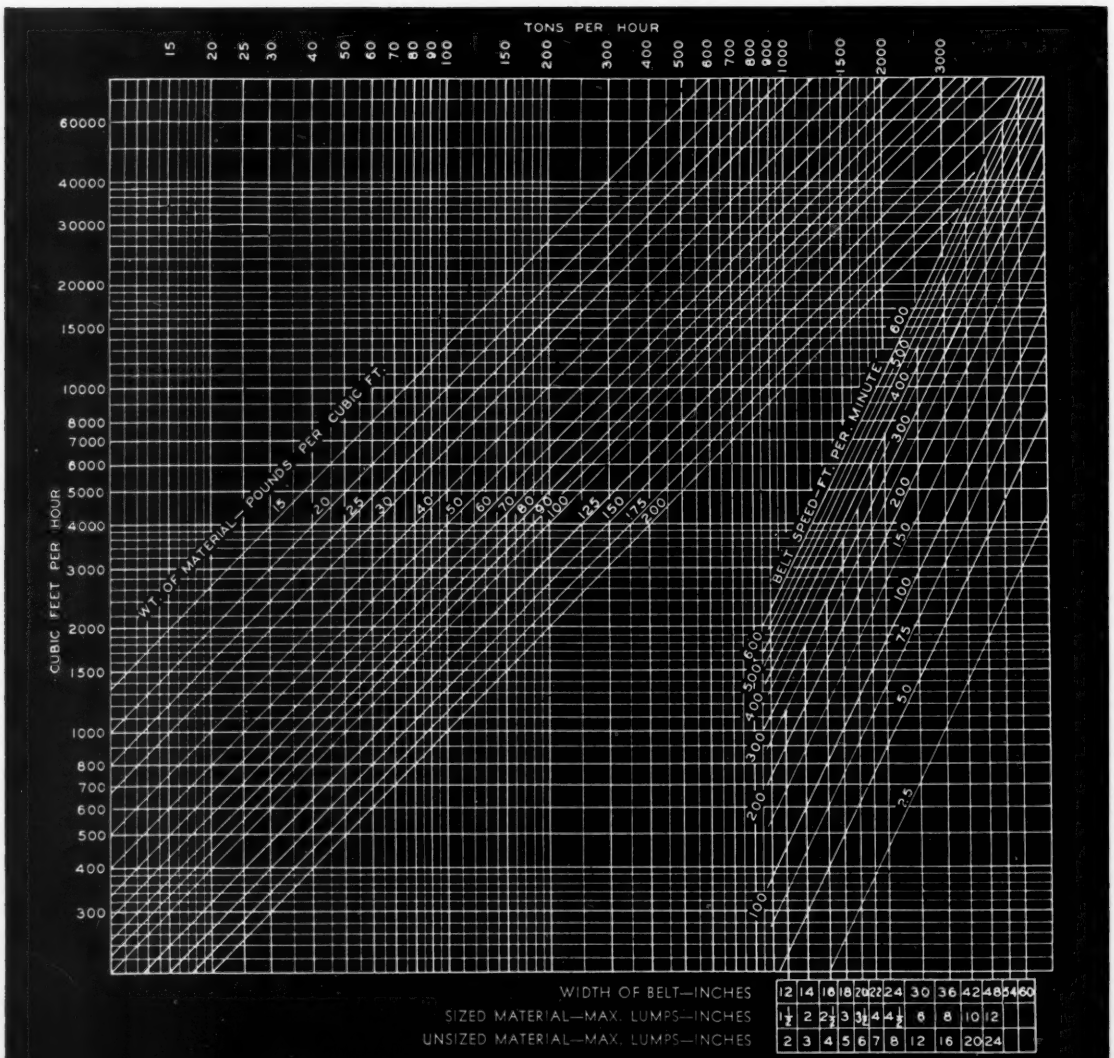
If JRH knows when the load goes off the compressor, he can have some one stand by the pump beforehand and slow down the pump for a few minutes or, if possible, have a city water line connected into the suction line near the pump and allow just enough cold water to enter the pump to prevent it from becoming steam bound.

Of course, admitting cold water isn't good practice because of the danger of cracking the pump.

The valves in the pumps in this case have nothing to do with the slamming, since the truoble happens when the load goes off the compressor. We have a similar condition.

New York JOHN MCCORMACK

Belt Conveyor Capacity Chart



TO USE CHART

Enter chart at top at desired tons per hour. Trace down to weight of material. Then to right to desired speed. Then down on first vertical to right of intersection with speed line and read width of belt. If belt thus found is too small for max. size lumps as shown by figures below belt widths, take belt width to suit max. lumps, follow up to cu. ft. per hour line and read speed required. Given capacity of any belt, enter on belt line and reverse above procedure. Note:—Capacities given by chart are for troughed belt. Reduce one-half for flat belt. Termination of belt width lines shows max. advisable speeds for given width of belt.

IMPORTANT

Chart capacities are based on uniform and continuous loading of material on belt. For intermittent loading pick belt and speed for maximum capacity likely to occur.

Courtesy—Dodge Manufacturing Corp.

Traveling Grate, Spreader Feed Stoker

LARGE boiler units can now utilize the advantages of the spreader stoker with the newly designed Travl-Spred Stoker which combines the spreader feed principle with the traveling grate. Manufactured by the Wm. Bros Boiler and Manufacturing Co., Minneapolis, Minn., the Travl-Spred Stoker offers these distinctive features: 1. Patented tuyere type grate surface; 2. Zoned burning area; 3. Compact hydraulic drive.

The non-sifting tuyeres are said to provide complete mixing of air with fuel at low static pressure, using less power and reducing the tendency of creating fly ash. Consisting of individual units, these tuyeres form a grate surface through which air is accurately metered. Orifices below the grate line diffuse the air at the grate line through enlarged openings.

Low velocity results from the criss-cross of air streams. Total air opening at the orifice points is only 7 per cent of the total grate surface.

The Bros system of zoned burning areas insures the proper proportion of air, and better control of the fire. With the ash bed thin at the rear and thick at the discharge front of the stoker, the control of air is necessary to compensate for the variation of the fuel bed. Three manually adjusted openings over the entire grate length permit absolute control of the fire. A rear zone near the bridge wall, a main burning zone and a generous burn-off zone minimize the carbon loss even when burning the poorest grade fuel.

The grate moves continuously forward at a rate of about four feet an hour. Over the "burn off" zone it receives no fresh coal, so that only ash is left to drop into a hopper at the end of the travel.

The hydraulic oil drive is described as representing an important improvement over the conventional chain grate drive; the unit is more compact, more accessible, and requires less driving power. The motor is rated at only ½ hp.

To make the drive safer, a relief valve which eliminates all safety clutches and shear pins is used. Valuable boiler room space is saved by placing the driving units in the air duct extension under boiler sidewalls. The few moving parts are accessible by removing the lower side of housing.

The complete self-contained drive running in oil is ruggedly built, though so simple and compact that no basement or excavation under the boilers is necessary. Even side support members are utilized as air ducts.

Because no bulky gear reduction machinery is necessary, the stoker is readily adaptable to existing boiler rooms. It conforms to present and future space limitations.

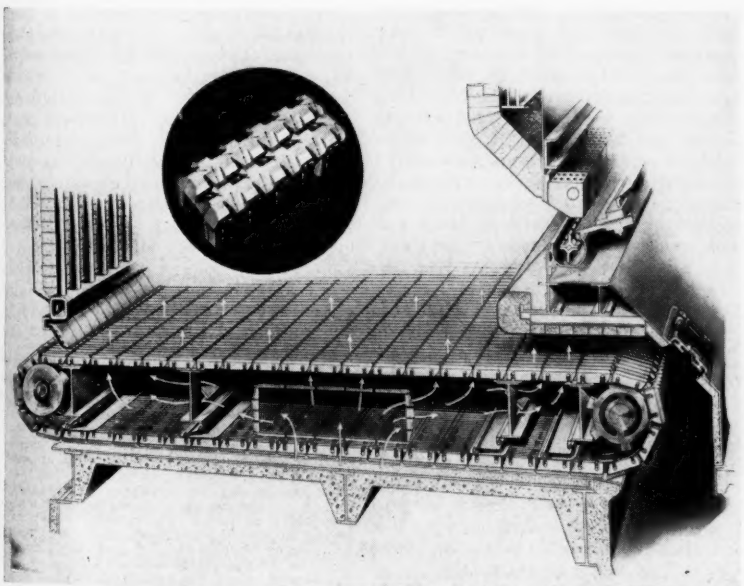


Fig. 1. Controlled air travels through the entire grate surface of this stoker. From a forced draft fan the air travels through a side duct before entering the main burning zone. Manually adjusted dampers permit control of the fire on the thin ash bed at the rear and the thick bed at the discharge end. The grate surface is made up of individual tuyeres like that shown in inset

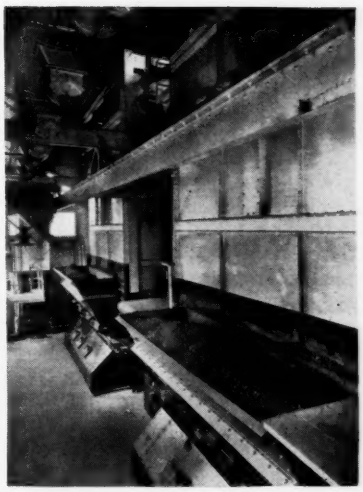


Fig. 2. This stoker is installed at the Chicago, Milwaukee, St. Paul and Pacific railroad in Milwaukee, Wisconsin

The manufacturer claims these advantages for the stoker: flexibility, ease of control, high efficiency and the ability to burn low-grade high fusion coals.

The continuous ash discharge feature aids the advantage of maintaining constant rating and efficiency by the elimination of firing and ash cleaning periods. Higher efficiency is also gained by this feature as carbon loss always encountered in dumping a conventional grate stoker is greatly reduced.

The same feeding principle employed in the Bros Super-Spread Stoker is used in the new Travl-Spred model. Coal is spread evenly over the entire grate after being sprinkled into the furnace by an overrunning rotor. Fires burn in suspension and larger pieces form a shallow fuel bed on the grate.

Even with low-grade fuels, Travl-Spred maintains high burning rates. Preheated air, admitted to the coal stream through the moving tuyere grate, aids in the combustion of the gases from the fire.

Low maintenance costs are claimed for the Bros Travl-Spred Stoker. The tuyere type grates require a minimum of attention. Water cooled stoker frames and bearings enable constant operation.

Stoker, fan and grate operate continuously. Fuel and air supply, as well as grate speed, are adaptable to control by modulating combustion control system.

Since 1900 a standard lamp socket and base has replaced the 175 sizes formerly used in residential installations, says a Twentieth Century Fund report.

During 1926-1934 additions to world nitrogen capacity, almost wholly synthetic, were more than 150 per cent greater than the total average annual capacity in the industry's first hundred years, says a Twentieth Century Fund report.

Power Plant Services for Synthetic Gasoline Manufacture

By **GEORGE ROBERTS, JR.**, Manager, Research Dept., and
J. A. PHINNEY, Research Group Supervisor, Stanolind Oil and Gas Co.

RAPIDLY NEARING commercial application in this country is the manufacture of synthetic gasoline by a process now under development. This process, derived from the Fischer-Tropsch process developed in 1926 by two German scientists is variously designated the Synthol process, the Synthene process, the Hydrocol process.

The German engineers, Fischer and Tropsch, found in 1926 that the basic reaction in the manufacture of synthetic gasoline is the combination of hydrogen and carbon monoxide to form hydrocarbons and water. They found that if water gas, consisting primarily of hydrogen and carbon monoxide, was passed through a bed of iron particles impregnated with alkali, condensable hydrocarbons could be recovered from the effluent gases. Any material that can be made to yield carbon monoxide and hydrogen can serve as a raw material for the manufacture of synthetic gasoline; and the selection of the raw material depends primarily on the economics of the synthesis gas manufacturing step.

An intensive effort was made by the Germans to develop this reaction into a commercially feasible process, arising from the desire to have a source of liquid fuels for both military and peacetime utilization, independent of imports from other countries.

German Methods in 1938

In 1938 a total of nine Fischer-Tropsch plants were operating or under construction in Germany, the total capacity of which was about 11,500 bbl per day of oil. The basic raw material for this process was, of course, coal, which was converted to water gas containing hydrogen and carbon monoxide by reaction with steam, as shown in Fig. 1.

In the German commercial synthetic gasoline plants, synthesis gas was made on water gas sets which are widely employed both in this country and abroad, and need no extensive description. Each water gas set had a capacity for synthesis gas production equivalent to approximately 115 bbl per day of synthetic gasoline.

The design of a German synthesis reactor presents, primarily, a problem in close temperature control as well as provisions for heat removal. The synthesis reaction is quite highly exothermic, and the removal of large quantities of heat per unit of reaction chamber volume is therefore required. In addition, the synthesis reaction is quite sensitive to temperature, and very close control of temperature is believed necessary to avoid the formation of undesirable by-products. Two types of synthesis reactors were employed by the Germans, one designed for atmospheric pressure operation and the other for operation at approximately 100 psi. The catalyst was pre-formed, and because of the low heat conductivity of this catalytic material, the reactors were necessarily designed with very small distances between catalyst particles and cooling surfaces. Details of the construction of the two types of the German synthesis reactors are shown in Fig. 2.

Investment cost for commercial synthesis plants in Germany was high, of the order of $7500 to $8000 per daily barrel of product. In addition, operating labor requirement per unit of product was excessive, because of the large numbers of reaction vessels, each requiring close attention and control. These two factors, together with the low efficiency of conversion of coke to gasoline, combined to make the cost of production of synthetic oil according to the German technology so high that it is not competitive with natural petroleum products at current prices.*

American Interest in Synthetic Gasoline

In the American development of the synthetic gasoline process, as described by the authors before the ASME 1947 Spring Meeting, active interest in this country arose in 1938, although earlier investigations had been carried out on a minor scale. It was recognized that for synthetic gasoline to win a place in the competitive American petroleum picture, enormous improvements in efficiency and reduction in investment and operating cost through improved engineering over the German process would be imperative.

It was first decided that natural gas, under the present price structure, was a more economic source of carbon and hydrogen than coal, and research was undertaken to establish a feasible means for the conversion of natural gas into hydrogen and carbon monoxide.

Principles of Process

Methane reacts with steam and carbon dioxide to form carbon monoxide

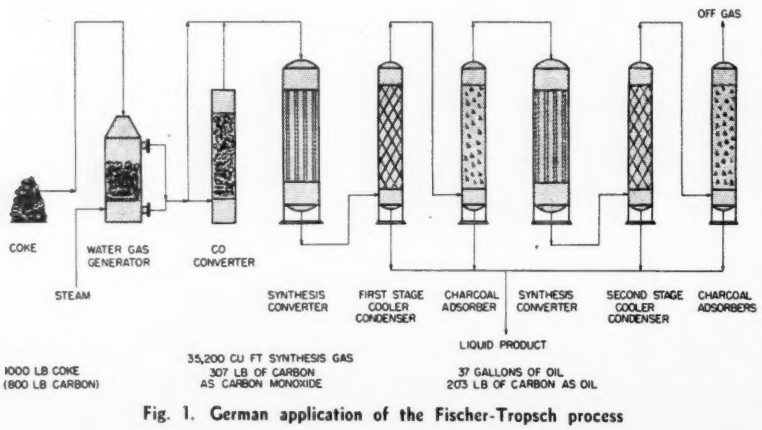


Fig. 1. German application of the Fischer-Tropsch process

* Synthetic gasoline produced via the Fischer-Tropsch process did not play an important part in the German oil technology during the war. While the synthetic oil production in Germany was expanded greatly over the war period, the major emphasis was placed on high pressure hydrogenation in spite of its relative costliness as compared to the Fischer-Tropsch process. This was done because the low quality of the Fischer-Tropsch gasoline by the German technique made it unusable as an aviation gasoline component. Hence, no new Fischer-Tropsch plants were built in Germany during the war, and the gasoline from the existing plants was delegated to motor fuel usage because of its low octane number. The Diesel fraction, however, was of superior quality and was used to up-grade low quality material from other sources. With the exception of the Diesel fraction, the Germans considered the products from the Fischer-Tropsch process as unsuitable for premium fuels and regarded them primarily as raw materials for further chemical and synthetics manufacture.

Process now nearing commercial development will have large and unusual power service facilities . . . Requires large volumes of oxygen . . . Centrifugal air compressors in two parallel units, each of 93,000 cfm capacity, and consisting of 2 compressors in series, driven by 600-psi steam turbines totaling 42,000 hp, compressing air to 102 psia . . . Centrifugal oxygen compressors of 17,700 cfm each, driven by 600-psi steam turbines, compress oxygen to 310 psia . . . First application in this country of centrifugal oxygen compressors for such a pressure range . . . Air expanders to provide refrigeration . . . Pressure-fired boiler, to cool synthesis gas, will have removable heat transfer surfaces, generate steam at 600 psi . . . Entire plant to require 1,200,000 lb per hr of 600-psi, 750 F steam. About two-thirds of this comes from the exothermic heat generated in the processes . . . Welded aluminum plate 1-in. and thicker to be used in oxygen plant, also much 18-8 stainless . . . Refractories must withstand 300 psi, 2500 F under reactions of preheated methane and oxygen . . . Conventional 650-psi steam and power generating plant of large size also required . . . Cooling tower of 133,000 gpm capacity . . . Unique engineering problems

and hydrogen. This reaction is carried out at atmospheric pressure and about 1500 F over catalyst, and since it requires heat, it is commercially carried out in a reformer furnace. In this type equipment, which is currently employed in the manufacture of hydrogen from natural gas, high alloy tubes are suspended vertically in a fired furnace, and the reacting gases pass downward through beds of catalyst contained in the tubes.

In the other process, methane combines with oxygen under pressure and temperature to produce carbon monoxide and hydrogen. This reaction gives off heat which may advantageously be used in other parts of the process. The partial combustion reaction has not been applied commercially at the present time, but, for reasons which will be explained later, appears to be more desirable for application in the synthetic gasoline development than the more fully developed reforming process.

The second step in the American synthetic gasoline development is substantially the same as in the German development; namely, the conversion of mixtures of carbon monoxide and hydrogen to hydrocarbons. Again, tremendous improvements in technology have resulted in greatly increased efficiency and reduced investment cost over the German commercial application. Investment and manpower requirements for the synthesis reaction have been greatly reduced by the application of the fluidized technique, wherein a bed of finely divided solid catalyst is maintained in a turbulent state. The fluidized technique, wherein the rapidly circulating catalyst particles permit the transfer of enormous quantities of heat to adjoining cooling surfaces with a small temperature variation throughout the bed, is admirably suited to this reaction.

Details of One American Plan

Figure 3 shows diagramatically one scheme being studied for the manufacture of synthetic gasoline. Natural gas under pressure and oxygen are preheated and enter a combustion chamber, wherein conversion of the reacting gases to hydrogen and carbon monoxide takes place at approximately 300 lb pressure and 2500 F. These gases are cooled, with the evolution of useful heat, and enter the synthesis reactor which operates at approximately 200 lb pressure by conventional oil absorption techniques.

The recovery step does not differ greatly from the recovery of natural gasoline from gas and the techniques to be employed are similar. Light olefins produced in the process are polymerized to make high-octane gasoline. The efficiency of utilization of carbon from natural gas is considerably greater than that for the utilization of coal in the German technique, for 10,000 cu ft of natural gas containing approximately 340 lb of carbon is converted to one barrel of synthetic oil containing approximately 230 lb of carbon.

The partial combustion process has been shown in preference to the reforming process for synthesis gas manufacture previously described. The former process is more economic since it supplies large quantities of by-product heat and since it can be carried out at the pressure required for the synthesis and at which natural gas is usually available.

Unique Engineering Problems

In the synthetic gasoline process, a number of unique engineering problems occur. In the preparation of synthesis gas by partial combustion, large volumes of oxygen will be required, and this material is to be prepared by a modification of the Linde-Frankl technique of low temperature distillation. While this process has been employed for some time on a small scale for the manufacture of oxygen, consideration is being given in the contemplated installation, which is many times larger than any existing oxygen unit, to the possible improvement of the economics of the operation through the use of centrifugal air compressors, centrifugal expanders, reversing heat exchangers, and other modifications.

The air compressors consist of two parallel units. Each unit is made up of two compressors with their individual drivers operating in series. Considerations of operating flexibility indicated that separate drivers are more desirable. Each unit consists of one compressor handling 93,000 scfm (standard cubic feet per minute) from 13.2 psia to 40.5 psia and requiring 12,750 hp and the second stage compressor handling 93,000 scfm from 39 psia to 102 psia and requiring 8300 hp. The operating speeds for the respective units are 2800 rpm and 3000 rpm. The steam conditions for all turbines for the air compressors are 600 psi, 750 F at the throttle and exhaust to 3 in. Hg absolute. We believe that this installation, totalling 42,000 hp, will be the largest domestic installation of centrifugal compressor for compressing air to the final pressure mentioned above.

Centrifugal Oxygen Compressors

The oxygen compressors are unusual in that this is probably the first appli-

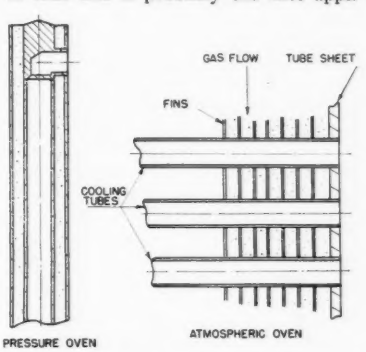


Fig. 2. Diagram of two types of German synthesis reactors

The atmospheric reactor consisted of a number of horizontal boiler tubes in rectangular box. Vertical to tubes were steel sheets, about 1/16 in. thick, spaced 0.3 in. Tubes expandel into holes in sheets, by forcing a ball through tubes. Each reactor had total tube surface of 4300 sq ft; total finned surface of 38,700 sq ft; total cooling surface of 43,000 sq ft. Capacity oil production each reactor only about 18 bbl per day. Weight of each reactor without insulation, about 90,000 lb.

Pressure reactor consisted of vertical cylindrical vessel, fitted with a double pipe system between tube sheets. Catalyst placed in annular space between inner and outer tubes; cooling water occupied space around outer tubes and inside inner tubes. Total cooling surface in each reactor about 22,600 sq ft; weight of each, exclusive of insulation, was 108,000 lb. Capacity for oil production of pressure reactor about 18 bbl per day. Overall volume of the atmospheric chamber was about 650 cu ft; overall volume of the high-pressure chamber of the order of 950 cu ft. Experiments indicated that capacities for oil production limited entirely by ability to remove heat with good temperature control rather than by specific catalyst activity; i.e., same volume of catalyst could produce considerably more oil if design of reactor had been improved to permit increased heat removal per unit of catalyst volume.

In practice, four chambers were operated as unit with common cooling system, temperature being controlled by adjustment of pressure on evaporating water system. In average German unit of 1300 bbl per day capacity, approximately 72 reaction chambers would be on stream with 18 separate control systems required.

cation in this country of centrifugal compressors for compressing oxygen from 15.5 psia to 310 psia. The quantity of oxygen handled by each of the two units is 17,700 scfm. Each of these units consists of three compressors operating in series. The first two machines are driven by a common turbine of 4760 hp and the last stage of compression is handled by a separate compressor and driver of 1720 hp. Steam conditions for these turbines are 600 psi, 750 F at the throttle and exhausting at 185 psi and about 500 F.

The air expanders, used to provide refrigeration, will operate at a speed of approximately 9000 rpm, inlet pressure about 91 psia, outlet pressure 21 psia with inlet and outlet temperatures of —233 F and —305 F, respectively. Units of the size required for the job have never been employed previously.

The use of aluminum as one of the materials of construction for the process equipment in the oxygen plant presents some unusual fabricating problems. These are mainly problems that arise in the welding of aluminum plate in thicknesses greater than 1 in. A large part of the process equipment for the oxygen plant will be fabricated from 18-8 stainless.

The next step in the process, involves the partial combustion of the natural gas with oxygen. In this step, as previously pointed out, preheated methane and oxygen are mixed and react under pressures of about 300 psi and 2500 F temperature. The selection of suitable refractory materials to withstand the extremely high temperatures in the prevailing atmosphere, the design of suitable mixing equipment for the methane oxygen, and the provision of adequate protection against excessive temperatures in the vessel walls constitute some of the problems.

Present plans for the Synthesis Gas Generators are that a boiler will be used as a means of cooling the synthesis gas. We believe that this will be the first application of a pressure-fired boiler operating at these conditions. The unit is being designed so that the heat transfer surface is removable for maintenance. The steam generating pressure will be approximately 650 psi. Water cooled walls will be provided to maintain a safe metal temperature on the shell of the vessel.

As an indication of the improved technology over the German method of synthesis gas manufacture, wherein one water gas set had gas generation capacity equivalent to a daily production of 115 barrels of synthetic oil, in the proposed equipment synthesis gas equivalent to 3000 bbl per day of oil is produced in one vessel of 2000 cu ft volume, which also contains cooling surface sufficient to remove waste heat. Thus, only two such vessels are expected to be required for a commercial synthetic gasoline plant of 6000 bbl per day capacity.

Synthesis Converter Problems

The design of the synthesis converters also introduces a number of interesting engineering problems. These include the provision of adequate cooling surface within the reaction vessel, without interference in the necessary turbulence of the fluidized catalyst particles, a selection of materials of construction to withstand the abrasive action of the catalyst at the prevailing conditions of pressure and temperature, and the design of suitable equipment for the separation of suspended catalyst particles from the product gases leaving the reactor. In one design it is contemplated that a vessel of approximately 3400 cu ft volume will have a capacity for production of 1000 daily barrels of synthetic oil. This may be compared with the standard German reactor of 950 cu ft volume. Thus, in a commercial plant, six reactors would be required to produce 6000 bbl per day of oil whereas by the German technique some 300 reactor units would be required. Approximately 350,000 lb per hr of 650 psi steam would be generated in the synthesis reactors.

Approximately 1,000,000,000 cu ft per day of gas are handled through the reactor section of a 6000 bbl per day plant. Recycle compressors handle

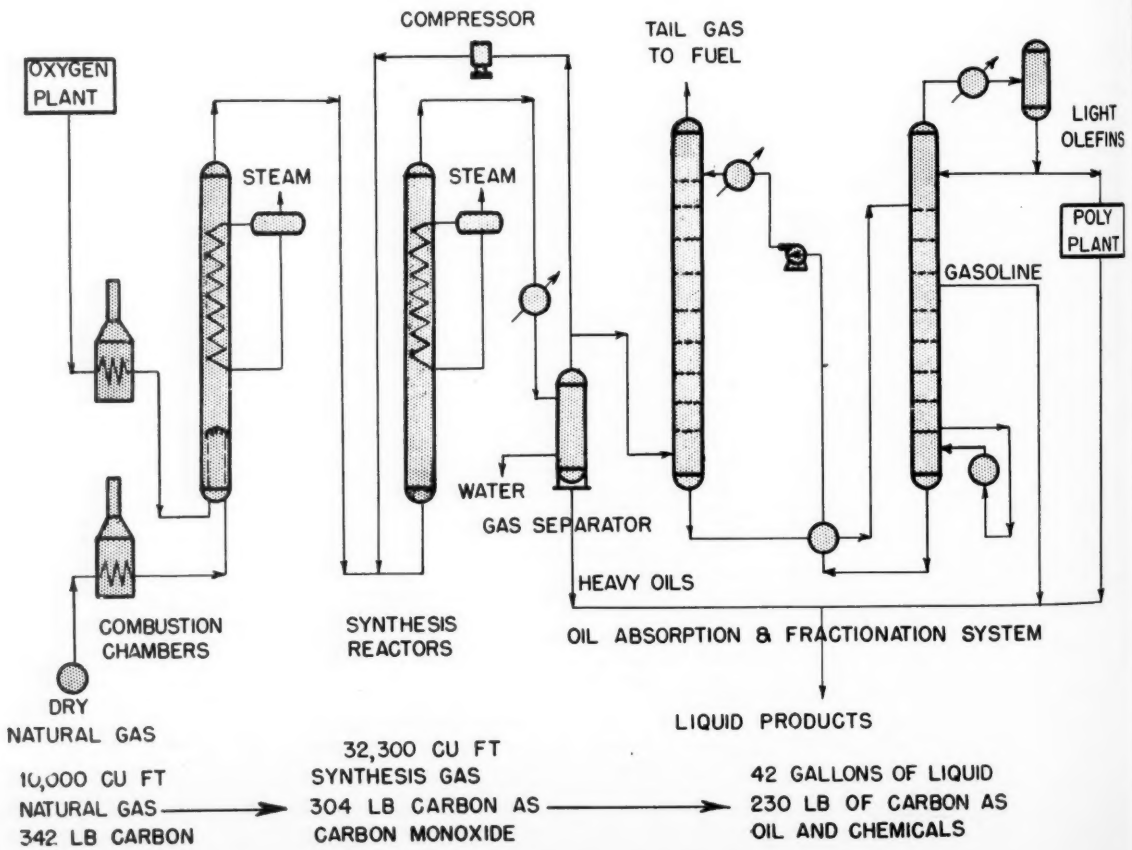


Fig. 3. American application of the Fischer-Tropsch process, showing how exothermic reactions generate steam

about 750,000,000 cubic feet per day of this gas quantity. These are of the centrifugal type operating at 250 psi suction pressure with a differential pressure of about 30 psi. Large quantities of heat (340,000,000 Btu per hr) are transferred by gas to gas exchangers requiring a large amount of surface.

The fractionating and recovery equipment for the recovery and finishing of hydrocarbons and chemicals is largely conventional. The equipment for the catalytic polymerization unit does not present any particular problems that have not been previously solved.

Complete Standard 650-psi Plant of Large Size

The utility section of a synthetic gasoline plant is unusual only in size. The entire plant requires about 1,200,000 lb per hr of steam at 600 psi and 750 F for normal operation. About two-thirds of this requirement can come from the process units mentioned above. Fired superheaters superheat the steam from the process generators. The cooling tower is also somewhat unusual because of its size; present designs require a water circulating capacity of 135,000 gpm with a 14 F approach. The rest of the equipment for this section is of ordinary design.

New Steels

Art of steel making advanced steadily but with increased activity to meet growing and broadening market demands*

By MILTON MALE, Research Engineer
United States Steel Corporation of Delaware

SINCE the period of modern steel making began with the development, in 1854, of the Bessemer converter, and as the open hearth process entered the field ten years later, the growth and refinement of the art of steel making has been a gradual but continuous process over almost a century, with a notable speeding up in recent years. These refinements include prolonged studies of the chemistry of steel making, systematic investigations into the effects of hot and cold working, and the perfection of scientific methods of heat treatment. In spite of the fact that such gradual developments do not make headlines, the immense amount of research work on the broad range of carbon, alloy and stainless steels, on the perfection of metallic and non-metallic coatings of many kinds, makes them varied, versatile and refined to a degree hardly imagined even ten years ago.

Recent experience gained during the war is certain to lead to improved methods of manufacture of products made of steel. Advances may be expected in the design of steel articles; in fact, this is the field in which changes may be most widely apparent to the general public.

One of the significant developments of the war years was the recognition of the importance of hardenability. The trend during the last two years has been toward an ever increasing application of this concept to the selection of steel for machine parts.

The newer understanding of the function of hardenability has led to a demand for steels in which the hardenability is restricted to a specified range. Such steels are known as "H" steels, and their hardenability ranges as "hardenability bands."

An interesting development, toward somewhat the same end, is the use of boron, in very minute percentages, to increase hardenability. An addition of as little as 0.001 per cent, equivalent to about ⅓ of an ounce per ton, will nearly double the hardenable size of section.

A new multi-purpose steel was announced in 1946—Stainless W. This new steel is a working steel and will find broad use in industrial machines. It combines the high strength and corrosion resistance of standard 18-8 stainless steel with hardenability obtained through heat treatment. It contains titanium in the range of about 0.40 to 1 per cent to produce precipitation hardening. As a matter of passing interest, Stainless W unlike the well-known 18-8 stainless steels, is magnetic.

Preliminary commercial applications of Stainless W indicate its usefulness where strength, hardness and corrosion resistance, all or in part, are essential; as in cams and rollers in food handling and bottling equipment. It also shows promise for application in bearings, pump valves, and seats, plug valves and other parts, for food, oil and chemical industries. It is unique in that it is amenable to heat treatment to develop high hardness throughout large cross sections.

Another new grade of steel is a carbon-molybdenum-chromium composition, a "stabilized" steel designed to meet requirements of increasingly high temperatures in the steam lines of power plants and in the chemical industries. This steel possesses enhanced resistance to graphitization and loss of creep strength when used at temperatures up to 1100 F.

The trend of applications for Cor-Ten and similar low-alloy high-tensile steels is accelerating now. Wherever high strength and corrosion resistance can be used in the construction of mobile equipment, such as railroad rolling stock, busses, and trucks and trailers, these steels will play an important part in reducing dead weight with an important economic gain.

As an interesting example of a new use for old materials, consider tiny steel wires, 0.0059 in. thick, used for plies in rubber tires. The wire used is extremely high grade with tensile strengths ranging from 325,000 to 400,000 lb per sq in. This quality product lends itself to a number of uses such as reinforcement for V-belts, power transmission belts and conveyor belts, where strength and endurance must be combined with a high degree of flexibility.

* From a paper presented before the Society for Advancement of Management.

GAS-TURBINE TEST DEVELOPMENT

TWO DEVELOPMENTAL gas turbines, one a 5000-kw machine for electric power stations and the other a 4800-hp plant, are now under construction. Shop tests of the 4800-hp turbine are scheduled to begin soon. The other unit is in the design stage and will not undergo test until 1948.

The 4800-hp model will burn oil known as bunker "C" fuel, although research is being carried on in the use of pulverized coal to permit more diversified applictaion of gas turbines.

In the stationary gas turbine, which also will be fired with oil, air flows through two compressors, an intervening inter-cooler, a regenerator, and then into six combustion chambers. Nominal inlet temperature to the turbine will be approximately 1500 F, with the gases expanding first through a turbine which drives the high-pressure compressor. The remainder of the expansion occurs through a second turbine which drives the low-pressure compressor.

Engineers are engaged in extensive testing of various phases of gas turbines, and facilities for still further research are nearing completion. Facilities will soon be in operation for large-scale testing of coal combustion for gas-turbine applications.

G. E. Review

THE SNOOPERSCOPE or sniperscope, a wartime-developed instrument used to locate the enemy in darkness, is expected to find such peacetime applications as a supplement to or replacement for radar. The device makes use of infrared light and an electronically controlled telescopic sight to produce a clear image of objects that are invisible to the human eye in utter darkness. Among the possible uses are as a navigation device for ships and vehicles to permit detection of obstacles on very dark nights and as a crime detection and prevention device.

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Scientific vs. Popular Thinking On Atomic Energy

The importance of small things . . . The k factor in the development of the atomic bomb . . . Need for clear thinking on the part of those who have to decide on the control of atomic energy . . . The chemical versus the physical point of view . . . Possibility of discovering the ultimate constituent of matter . . . Space, matter and energy . . . Possibility of other particles existing in the nucleus . . . The positron and negatron; the mesotron . . . Why the scientists are concerned . . . The public mind regarding atomic energy

By **ANDREW W. KRAMER,** Managing Editor, Power Plant Engineering

MANY IMPORTANT projects have failed, not because their general outlines were drawn askew but because their projectors failed to take into account the immense importance of certain small details. If the human race were wise it could profit from this knowledge in its handling of atomic energy for this seems to be a case where the destinies of a planet pivot upon the nucleus of an atom.

Despite much argument and discussion, thus far, very little has been accomplished in placing atomic energy under international control, not because we do not have a workable plan, for the Baruch plan is workable, but because the statesmen and politicians fail to appreciate the tremendous importance of a certain small entity—the nucleus of the atom. They do not seem to understand that the destiny of our civilization is dependent upon what we do now with our newly-found knowledge of the nucleus. If the scientists working in nuclear physics in 1939, '40 and '41 had been as shortsighted, or perhaps we should say, as ignorant, there never would have been an atomic bomb, indeed, we would have known little about the release of nuclear energy. For the release of nuclear energy through the fission of uranium depends upon a certain small, but immensely important factor, which denotes the ratio between the number of neutrons produced by fission to the number that escape from or are absorbed by non-fissionable materials in a pile or bomb.

Importance of the K Factor

When a nucleus of Uranium 235 splits as the consequence of the capture of a neutron, it divides roughly into two equal parts. When this happens, the resulting nuclei have more neutrons than they can hold for stability [1] and so the excess neutrons are liberated. These liberated neutrons then become available to produce fission in other U-235 atoms, provided, they do not escape from the mass of uranium before they encounter another nucleus. Many of the neutrons do, in fact, so escape. The ratio between the number of neutrons originally present to the number that are produced by fission is called the multiplication factor—sometimes it is called the reproduction factor. Usually it is designed by the letter K.

In the early work on the atomic bomb, as described in the Smyth Report, little was known about the K factor but it was known to be very small. Obviously, to sustain a chain reaction, it should be greater than one; if not, the reaction would die out. As a matter of fact, the whole success or failure of the atomic bomb project depended upon the multiplication factor, K. If K could be made greater than 1 in a practical system, the project would succeed; if not, the chain reaction would never be more than a dream. If, for example, the number of new neutrons per 100 initial neutrons is 99, K = .99 and no chain reaction can maintain itself. The first value of K, reported by Fermi to the Uranium Section in the fall of 1941 was about 0.87. This was based on the second intermediate experiment at Columbia University. It was not until July 1942, that experiments were made where the multiplication constant K came out greater than one—it was 1.007.

This was the first indication of success, *seven one thousandths of a per cent,* yet upon that small margin, the success of the whole great Atomic Bomb Project depended. If the scientists who were doing the work had not

[1] See page 108, July issue.

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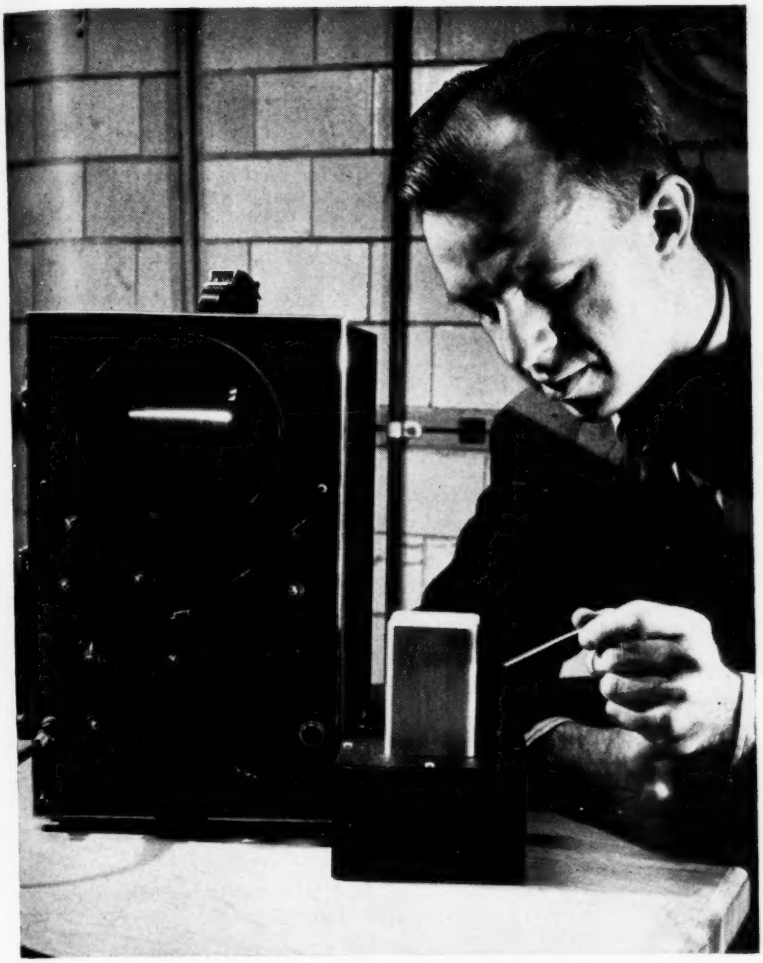

Fig. 1. New atomic ray detector. Radiations from exploding atoms are counted at the rate of 100,000 each second by this "atomic ray detector" shown in action here with Dr. Fitz-Hugh B. Marshall of the Westinghouse Research Laboratories. The new detector is fifty times more effective than the standard Geiger counter, which chokes up after 2,000 radiations a second have been reached. Dr. Marshall holds a small piece of wire tipped with radio-active material a few inches away from the detector, which is enclosed in the small light-tight box in the foreground. Particles from the exploding atoms penetrate the box and enter the detector, where they strike a fluorescent screen producing light which is converted to electricity and amplified 1 million times by a photomultiplier tube. This signal is then transmitted to the oscilloscope where the exploding atoms appear as flashing peaks of light

recognized the importance of this small factor—if they had not had confidence in the correctness of their knowledge, the project would have died almost at its inception.

Need for Clear Thinking

What the world needs most at this time is something of the same kind of clear and decisive thinking displayed by the scientists on the Atomic Bomb project, on the part of those whose function it is to deal with the question of atomic energy, politically—socially. As the Bulletin of the Atomic Scientists pointed out recently, "if there is something we cannot afford in dealing with atomic energy, it is muddled thinking, policy based on ignorance or wishful thinking." The justification for the intrusion of scientists into national and international affairs, is the compelling necessity for a factual realistic attitude as a basis of political decisions of our statesmen and political thinking of our citizens. The slogan "let's keep the secret of the atomic bomb" is as stupid and short-sighted as was the destruction of the cyclotrons in the laboratories of Japan in November 1945. No one seems to know who was responsible for the order that effected this destruction but it was as wanton and stupid, as the burning of the books by the Nazis. If the American scientists had had any voice in the matter these valuable devices would never have been destroyed.

Those who think we can keep the secret of the atomic bomb to ourselves do not realize how very new atomic energy is and because they do not, they cannot understand what future development in nuclear physics may bring forth. True, none of us know, but if the past record of scientific development is a criterion, no sane person can deny that what we have achieved now can be only a beginning—a drop in the proverbial bucket.

The scientific facts underlying the release of atomic energy were mostly available before 1940. The successful application of these facts in the atomic bomb was an engineering development of stupendous magnitude. Never before did application follow so closely on fundamental discovery. At present, the background of knowledge on nuclear structure has been pretty well used up; during the war, neither time nor the scientists themselves were available for work not connected with the production of the atomic bomb itself.

Now, however, research will proceed —at full blast, if not in this country, in other countries, and it is certain that during the next decade fundamental research in nuclear physics will disclose new facts concerning the nucleus of the atom which may prove of tremendous importance to the human race, for good or for bad.

For the first time man has discovered how to get into the nucleus of the atom and this knowledge alone brings us one step—and it is a big step—closer to the solution of the ultimate mystery of nature. The nucleus of the atom seems to be natures last stronghold against man's inquisitive disposition.

Knowledge of Chemistry vs. Nuclear Physics

Chemists have known for about 50 years that there exist only a finite number of chemical elements. These range from the simplest one— hydrogen—to atomic structures so complicated that they are unstable—the radioactive elements. The periodic table (the list of chemical elements arranged in accordance with their increasing mass) was formulated by Mendeleeff in 1871. At that time all the elements had not been discovered but so certain was Mendeleeff of the correctness of his theory that he did not hesitate to predict the existence of certain elements not then known—those represented by gaps in the periodic table. These were subsequently found. In the production of Neptunium and Plutonium, the periodic list of elements has been extended a trifle and while the possibility remains of the existence of some very unstable elements at the far end of the table the chemist knows that for all practical purposes the list is complete. The list of elements is definitely finite. And all evidence so far is against the possibility of fractional atomic or mass numbers. Chemists feel very certain, therefore, that they know all the possible types of chemical elements and that every atom consists of a central nucleus around which a specific number of electrons circulate.

The next unknown, therefore, concerns the composition and internal laws of the nucleus. This is the field of nuclear physics. Now, no matter what course, nuclear physics may take, only

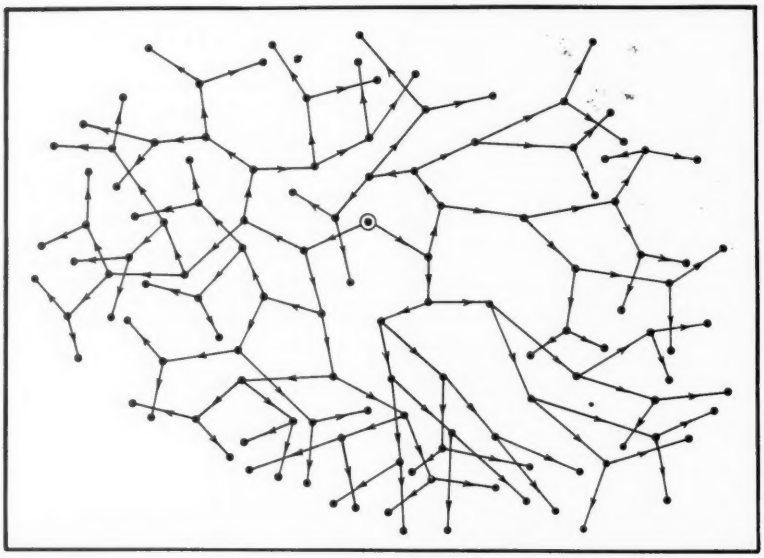

Fig. 2. Six consecutive steps in the development of a chain reaction with a multiplication factor of 2. The nucleus at the center splits up and emits 2 neutrons. Each of these 2 neutrons, in turn produce 2 other neutrons and so on. This diagram, then, shows the number of neutrons produced in 6 generations

one of two results can be attained; either the particles in the nucleus will be found to contain smaller particles, and these in turn still smaller particles, and so on ad infinitum—a view to which few present day physicists would subscribe—or else there must exist some final constituents of matter, which will be discovered some day.

Possibility of Discovering the Ultimate Constituent of Matter

The chances are very good that this day is not very far off. As pointed out by Prof. Philippe Le Corbeiller of Harvard in the Atlantic Monthly recently, there are two reasons for thinking that the final constituents of matter belong to the level of the newly found elementary particles (the neutron, proton, etc.) and not further down the scale. One is that these particles are defined by a very small number of properties—their mass and electric charge—so that they are very near ultimate simplicity. The other reason is that we are beginning to suspect that the concepts of space and distance, which we use in ordinary physics for describing objects on our scale, and which still work for objects the size of molecules, probably lose their meaning for dimensions much below one trillionth of an inch, such as would be needed to describe the inside of the nucleus. Thus, as Professor Le Corbeiller, points out, the ancient argument against atoms, that space is infinitely divisible, would be invalid at the levels of these particles, which is precisely what must happen if final particles actually exist.

The concept of space is meaningless in the absence of matter. Space is only recognized where there is matter. Now matter, has been shown to be a form of energy—a sort of crystallized form of radiant energy. Radiant energy seems to be related to space in some strange way for the speed of radiant energy in space is a constant. Space in fact is measured by the speed of radiant energy and, again, the concept of space is meaningless in the absence of radiant energy. Thus, since space is meaningless without either matter or radiant energy, the concept of space also disappears when we try to think of any space smaller than the final particle of matter. If there can be no particle of matter smaller than a minimum size, there can be no space of similar dimensions, since the whole idea of space disappears when there is no matter. What this really means, perhaps, is that only one thing exists in the Universe—energy. Space and matter are only manifestations of energy.

Thus, the scientist's quest for a solution of the ultimate mystery of nature is narrowing down—very much. We know, now, that the nucleus of the atom consists of two things—protons and neutrons, and as was explained in a previous article [2] each of these are capable of changing into the other, by the emission (or absorption) of energy.

True, the nuclear physicists have found evidence of other *material* elements in the nucleus—electrons, positrons (positive electrons) etc. Whether these electrons actually exist in the nucleus of the atom is not known; they emerge from nuclei but it is entirely possible that they are "born" at the instant of their emission by a change in the energy content of the nucleus.

Other Nuclear Elements

Other particles are the positive and negative mesotron or meson. These are positive and negative electrons possessing an abnormally high mass (about 180 times the rest mass of the electron), and they are unstable. Thus far, the mesotron has made its appearance only as a consequence of the action of cosmic radiation upon atomic nuclei. A great amount of energy is necessary to produce the mesotron—an amount that so far has been obtainable only from the cosmic ray. As more powerful accelerating equipment is built, however, it is more than likely that the mesotron will be produced in the laboratory.

Just what part, future nuclear research will disclose the mesotron to play in the structure of the nucleus it can play virtually no part in the application

[2] See page 110, July issue.

Fig. 3. A view of the magnet structure for the new 100,000,000 volt cyclotron to be installed at the radiation laboratory at McGill University in Montreal

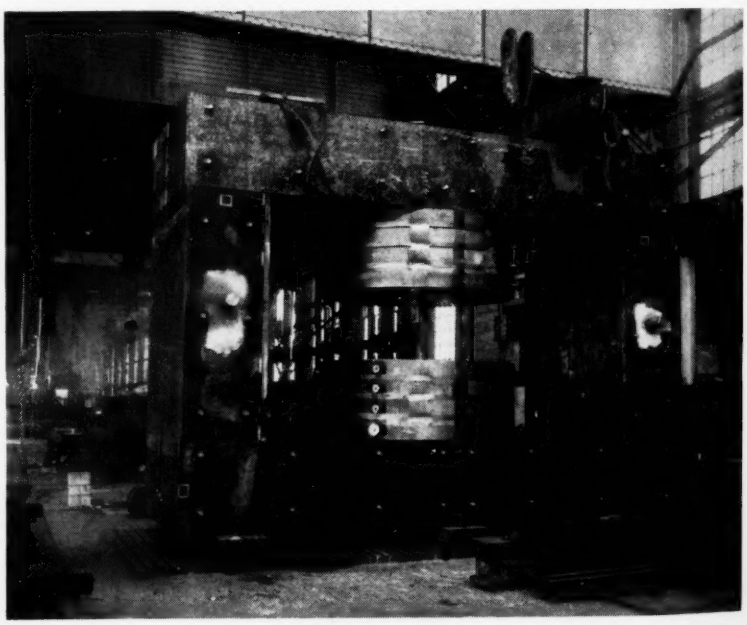

Fig. 4. Another new research tool. The new 70,000,000 volt Synchrotron in the General Electric Company's research laboratory at Schenectady

of nuclear physics to other purposes. It appears to be a manifestation of some change in the nucleus of the atom under the impact of cosmic radiation and it exists only for a very small instant of time; it reverts to an ordinary electron in a few millionths of a second.

Very little is known about the mesotron but by means of some of the very large cyclotrons now under construction, it is hoped that particles can be given sufficient energy to eject mesotrons from the nuclei of atoms—provided they are there.

The only reason for mentioning the mesotron here is to indicate that while the nucleus of the atom may consist of more than just protons and neutrons, the chances are, there are only two fundamental particles and that the others—the mesotrons and positrons and negatrons—are merely manifestations of changes in the energy content of the nucleus as a whole. In other words, it appears quite likely that the rock bottom simplicity, which has been found to be represented in chemistry by the hydrogen atom, is not far from being discovered in physics also.

If this proves to be true, the field of research may be narrowed down to the point where we will soon know a great deal more than we do now about releasing atomic energy. Thus far, nuclear fission can be produced only in the very heaviest elements; uranium, plutonium and thorium. Whether release of atomic energy from other materials can be achieved can be decided only by future research. At present no means of doing this are in sight but it must be remembered that the atomic bomb would have seemed fantastic to the best nuclear physicists in 1938.

The new cyclotrons, the new betatrons and synchrotrons, the new nuclear laboratories under construction in various parts of this country and in other countries will soon begin to contribute new fundamental knowledge—knowledge about very little things which will be of the most far reaching importance to the human race. The demonstration of nuclear fission in 1939 was an event of far greater importance than the mere fact that it led to the development of the atomic bomb.

It is significant that of all the people

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in the world, the scientists are the ones most concerned and worried about atomic energy. This, of course, is due to the fact that they understand it—they alone realize its full implications, particularly if its use is not placed under international control.

Much has been written in an attempt to make people cognizant of the dangers, but mere reiteration that the development of the atomic bomb is accessible to other countries and that there is no known defense against it will not necessarily jar the public into greater concern. People can accept such judgments without incorporating them into their attitudes and ways of thinking. As a matter of fact, in a recent survey,[3] a large group of people argued that the development of the bomb had made peace easier to keep rather than harder, because other countries were afraid of it and would not dare to provoke a war with us. Many of these same people, in answer to a direct question, declared freely that other countries would probably develop the bomb within a relatively short time. The information they had apparently absorbed had not shifted our monopoly of the bomb from the central position it occupied in their thinking.

Many people, of course, refuse to be worried over atomic energy merely on the grounds that they can do nothing about it. As one person who was questioned put it "I let the people who are qualified in those things do the worrying. I am just one of many people who accept circumstances as they are. To me, it is just like if you were living in a country where there were earthquakes. What good would it do you to go to bed every night worrying whether there would be an earthquake." Others find comfort in the belief that "you wouldn't even know it if one hit," or in "you cannot be killed any deader by an atomic bomb than you can by a bullet or a block buster."

Such views as these are undoubtedly subject to hasty revision in the face of imminent danger. There can be no doubt of the peoples' recognition of the terrible power of the atomic bomb, and a threatening incident involving the bomb would certainly cause a strong public reaction. But for most people the danger is not on the horizon. Accordingly, the bomb problem (and with it the whole question of the control of nuclear energy) suffers the same kind of popular neglect that many another less critical social problem receives.

[3] Committee on the Social Aspects of Atomic Energy of the Social Science Research Council.

Power Plant Construction Costs And Implications

Cost of electric power is not a factor in high construction costs . . . Despite rising costs of everything else, the cost of electricity has steadily decreased . . . Management's confidence in engineering . . . Should the utilities increase electric rates . . . Commodities affecting plant costs . . . Adjusting the cost index . . Future prospects

By WILLIAM F. RYAN, Assistant Engineering Manager
Stone & Webster Engineering Corporation, Boston, Massachusetts

CONSTRUCTION COSTS are so high that we find it difficult to believe the figures. When we study the costs of a completed project, we instinctively feel that the work must have been extravagantly designed, or badly managed. Estimates for projected work are even more incredible, and this applies equally whether we plan to build a power station, a school house, or a new porch on an old house.

There are many factors in the present high cost level, but the price of electric power is not one of them. Power is an appreciable item in the manufacturing costs of equipment and materials, but it is one component that has not contributed to the rising commodity markets. Throughout our dizzy cycles of booms and depressions, the end of each full swing of the pendulum has found electric power delivered to the consumer at lower cost than it was at the beginning, even though the cost of every major element entering into its production had increased during the same period.

We are all familiar with various indices for Cost of Living. They consist of certain arbitrary combinations of relative costs of food, rent, clothing and other commodities and services. Figure 1 shows the trend of some of the major items comprising the public utility's "Cost of Living."

The cost of fuel has had more violent fluctuations than some other components but the long term trend has been ever upward throughout the life of the electric power industry. It is now delivered at about 2½ times the average price prior to World War I, and nearly twice what it cost just before World War II. It is not, however, even today at its all time peak, which was reached in 1920. The hourly cost of operating labor has had many ups and no downs during that period. It is now at its all time high, 5½ times what it was in 1914 and nearly twice what it was in 1939. A third major component in the price of power—the cost of plant—is one with which we are here concerned. This factor also, when plotted against time, appears to have the profile of a roller coaster with steep ascents and less precipitous, but breathtaking, drops, until we discover one important difference. The roller coaster always returns to the level from which it started. This, unfortunately, the cost of Electric Plant has failed to do so far, and there is no probability that it ever will.

All of these components of production expense had a sharp rise during and after World War I, and except for operating labor, a substantial decline three years after the end of hostilities. The subsequent trends have been mostly upward except for utility bond interest rates which are now at a relatively low level.

The index for bond interest is a national average, while that for Electric Plant has a more limited application, which will be described later. The indices for fuel and labor were taken from single utilities in the northeast, because there are no continuous records for the industry as a whole. Nation wide statistics are available for the price of coal at the mines, but that index presents a distorted picture for the majority of generating plants. A comparison of these particular indices with discontinuous records indicates that, as a long term trend, they are generally applicable and show, with reasonable accuracy, the conditions with which the public utility has had to contend since 1914.

Every appreciable item in production expense for electric power has risen steadily, cycle by cycle, but the industry has continued to deliver its product, the life blood of our national economy, at lower and lower costs. While skillful

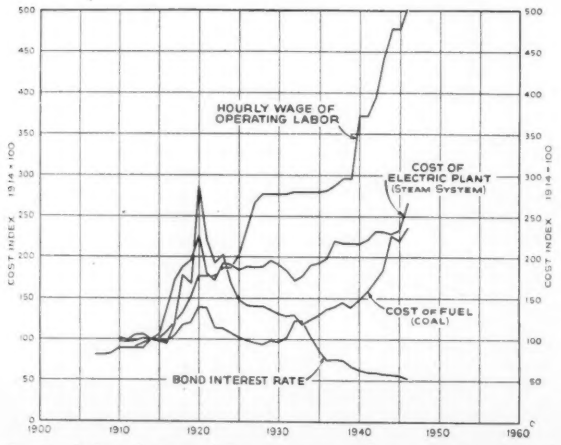


Fig. 1. Index of Cost of Some Important Factors in the Cost of Producing Electric Power

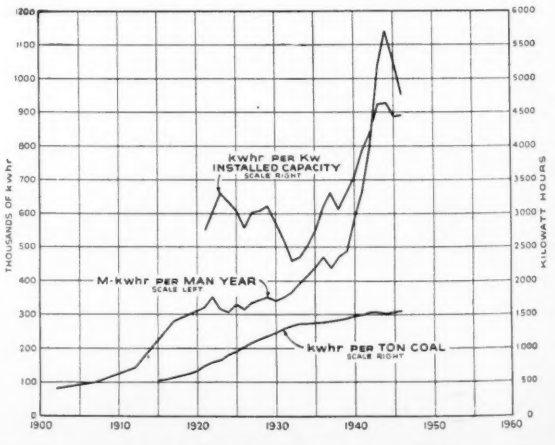


Fig. 2. Productivity of American Electric Power Generation. Note how the output per Man Year has increased

marketing has played an important part in this achievement, it is largely the product of technological advances and a triumph of sound engineering. The salesmen and rate-makers who sell more and more kilowatts year by year make it possible for the engineers to install larger generating units of higher efficiency. An even more important marketing accomplishment is the mounting ratio of kilowatthours sold to kilowatts of demand, increasing the earning power of every dollar invested in plant and most of the dollars spent for operating labor. In this assembly one may even give due credit to the type of management which, by consolidation and integration, has made it possible to eliminate inefficient production units and to avoid wasteful duplication of services and administration. Nevertheless it is technological progress which has made it possible to double the output of kilowatthours per ton of coal in the last 25 yr, to produce great concentrations of power from a few large units instead of a multiplicity of small ones and to interconnect vast systems so that every dollar invested in generating plant extends its potential usefulness over a wider area.

Management's Confidence in Engineering

We can not claim credit for the engineers, however, without paying tribute to the management which has had the courage and the foresight to let the engineers have their head. In no other industry have engineers been given greater opportunity to pioneer and to develop their art. Whenever the engineers have determined that an unprecedented design is economically sound, management has been willing to risk its capital on their judgment, and results prove that this confidence has not been misplaced.

Figure 2 shows graphically the basic reasons why the electric industry has been able to pay more and more for all it buys, yet sells its product for less and less.

Figure 1 and Fig. 2 combined constitute a lesson in economics that should be impressed upon every wage earner and every politician. These graphs show that our economy can support high wages if the wage earner is sufficiently productive. No industry has a better record for increased productivity than the public utilities,[1] and Fig. 2 illustrates some of their outstanding achievements. Output per ton of coal burned has increased from 525 kwhr in 1915 to 1550 kwhr in 1946. Kilowatthours per man year of labor have increased from 83,000 in 1902 to more than 1,000,000 in 1943 and 1944. There has been a decline, which may or may not be ominous, since 1944. The productivity of capital investment, with which we are here concerned, has likewise increased. Whereas we were generating less than 3000 kwhr per kilowatt of capacity in the boom years from 1915 to 1920, we generated more than 4600 kwhr per kilowatt in 1944. There was a slight decrease in '45 and '46 but, at the present rate of output, we will in all probability reach an output of more than 4700 kwhr per kilowatt in 1947. The increase in productivity of capital investment is especially high for Steam Production Plant, for which output per kilowatt of capacity increased from 1875 in the depression year of 1932 to about 4121 in 1946.

The increase in productivity here shown has made it possible to lower rates almost continuously, but how much longer can technological progress stem this tide of rising costs? We may hope that the costs of plant, fuel and labor which comprise the cost of power have ceilings, but we know that the selling price has a floor. It can not go down forever. Perhaps we have already touched bottom. Perhaps the long term trend has been reversed and the day is approaching when public utilities must swallow their pride and demand an increase in rates.

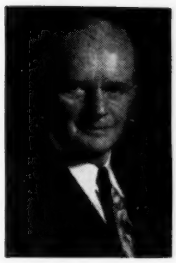
Shall the Utilities Increase Electric Rates?

And why not? Wages, we are told, must be adjusted to the "Cost of Living." If Fig. 1 shows what has happened to the public utility's cost of living, then an increase in the public utility's wages is clearly indicated. Electric power is a valuable commodity, as indispensable as fuel or steel, and in times like these, why should the consumer not expect to pay more? There is the rub. He may be willing to pay more at a time when his own production and selling prices are at their peak, but when his business slumps, and his selling prices drop, then he is going to complain if his power costs do not drop in some proportion.

Referring again to Fig. 1, the coal bought at the top of the market in 1920 was burned and replaced by cheaper coal, but the plant built that year stayed on through the subsequent depression, trying desperately to earn a fair return on its cost. Rates may be adjusted upward or downward to follow the price of fuel without excessive complaint from the consumer, but what we invest in Electric Plant at the peak of the market is frozen at that level for its useful life. Rates can not be lowered because construction costs have come down without sacrificing reasonable return on the investment already made. Therefore, as a matter of business prudence as well as professional pride, we should like to hold the line, and prevent any permanent increase in delivered costs of electric power.

If holding the line depends on cost of plant, the future does not look too hopeful. However, our judgment in regard to the future of plant cost may be

[1] "Output and Productivity in Electric and Gas Utilities 1889-1942." National Bureau of Economic Research, 1946.



Among the more important addresses before the Edison Electric Institute Convention at Atlantic City in June of this year, one that was outstanding in its importance and scope was W. F. Ryan's address on construction costs and implications. In this address Mr. Ryan analyzed the trend of construction costs over the past 40 years and discussed the probable effect of the present trend upon the future development of the industry. Much of the substance of Mr. Ryan's address was based upon the accurate cost records of the Stone & Webster Engineering Corporation and his analysis should be of interest to all power engineers, both utility and private plant men.

William F. Ryan was born in Woodbury, Connecticut, May 18, 1899. He was educated in the public schools of Everett, Massachusetts and at Harvard University, receiving the degree of A.B. in 1911 and the degree of M.M.E. in 1913. For four years after graduation he was employed by the Interborough Rapid Transit Company in New York, his time being about equally divided between steam power plant construction and operation. He became Chief Power Plant engineer for the Wright Martin Aircraft Corporation, New Brunswick, New Jersey, and later was Mechanical Engineer for the Harry M. Hope Engineering Corporation in Boston, first on operation and later on design of steam power plants.

From 1924 to 1929 he was employed by subsidiaries of the Allied Chemical and Dye Corporation at Syracuse, New York, and during this period was responsible for the design of the first (industrial) high pressure topping plant in the United States. Since 1929 he has been with Stone & Webster Engineering Corporation and, during that period, as Mechanical Engineer and Assistant Chief Mechanical Engineer, he was responsible for the design of numerous chemical and industrial plants, as well as public utility power stations totaling about 2,000,000 kw in capacity. He has also acted as consultant to utilities in matters affecting system development, tax valuations and rate schedules.

Mr. Ryan is a Fellow of the A.S.M.E., a Director of the National Society of Professional Engineers and President of the New England Section of the Harvard Engineering Society. He is currently serving on the Engineers' Joint Council Committee on the Economic Status of the Engineer.

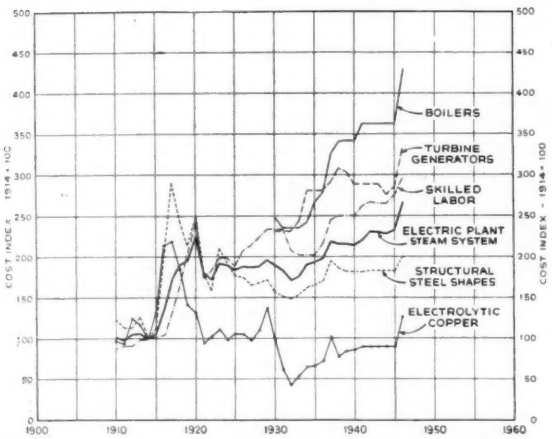


Fig. 3. Index of a number of Electric Plant Costs and Some Factors Affecting Them

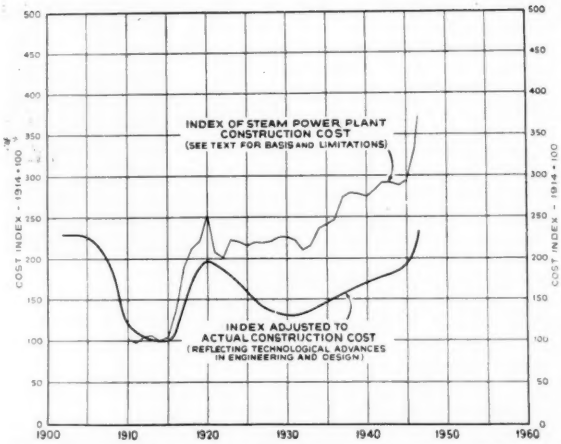

INDEX OF STEAM POWER PLANT CONSTRUCTION COST
(SEE TEXT FOR BASIS AND LIMITATIONS)
INDEX ADJUSTED TO ACTUAL CONSTRUCTION COST
(REFLECTING TECHNOLOGICAL ADVANCES IN ENGINEERING AND DESIGN)
COST INDEX - 1914 = 100

Fig. 4. Index of Steam Power Plant Construction Cost, and Adjusted Index, Reflecting Technological Advances

distorted by the situation in which we find ourselves at the moment. If you can conceive of an elevator in the Empire State Building getting out of control on its upward flight, and can imagine the feelings of the operator as he passes the 81st floor, then you can appreciate the sensations of a construction engineer in June 1947, trying to estimate the cost of a power plant which is scheduled for completion in February 1951!

Our man in the elevator knows he is high, and is reasonably sure he is going higher. He is confident that eventually he, or his remains, will reach a lower elevation, but speculating on what is going to happen in the meantime may cause him some perturbation.

If it is a matter of any interest, his executors may determine the path by which he reached the 81st floor, and we can at least do that much with respect to the cost of Electric Plant.

Like production expense, the cost of plant has many elements, and price trends of all these elements have been carefully recorded over the years, plotted as indices and combined to form an index for total cost of plant.

Figure 3 shows an index repeated from Fig. 1. It is a graphic representation of the relative cost of Electric Plant in a particular region of the United States from 1910 to the present for a system on which all power is steam generated. The sharp rise beginning with the outbreak of World War I in Europe reached a peak of 225, (1914 being 100), there years after the war was ended. This is an ascent of 125 per cent in six years. From that time till now, this index has never dropped below 170. In general, the postwar index reached a plateau about 75 per cent above prewar levels. After maintaining a reasonable stability for about 10 years, it started climbing gradually, acquiring a sort of running start, and now appears to be taking off "into the bright blue yonder." Some other indices turned down in April of this year, heralding the possibility that a postwar peak may be at hand, but price increases were announced in May for turbine generators and other important equipment, and there was a general increase in wages for construction labor. This index for Electric Plant has not turned down.

Commodities Affecting Plant Cost

For purposes of comparison, we have shown on this chart the indices of some commodities which affect the cost of Electric Plant. First, we show two important basic materials—copper and steel. The graph discloses how fortunate we are that copper is such an important element in Electric Plant. Compared with other commodities it has been cheap since World War I. In spite of recent price increases, it is still relatively cheap. The indices for steel and skilled labor roughly parallel the combined index for Electric Plant, but the indices for some items of major equipment are up in the stratosphere. Largely as a result of equipment cost, the index for Steam Production Plant is higher than this average for combined Electric Plant.

If common labor were shown on this comparison, it would have gone off the chart about 1938, and is now over 600, but common labor is a factor of dwindling importance in construction costs. Shop labor no doubt has soared somewhat in proportion to common labor and accounts in large measure for the soaring indices of equipment costs.

At this point some comment may be in order regarding indices in general, and this index in particular. You are all familiar with the Engineering News Record Indices of Building and Construction Costs. Each of these is the sum of certain quantities of building materials at current prices, plus the sum of a certain number of hours of skilled or unskilled labor at current wages, compared with the sum of the same quantities and hours at the prices and wages prevailing in the base year, 1913. An index of this type assumes the same ratio of labor hours to material quantities from year to year. It ignores the fact that a mason may lay fewer bricks per hour in 1947 than in 1913, or that an electrician may have pulled more wire in a 40 hour week in 1932 than he does now in a 53 hour week for which he gets 66 hours pay. In other words, it ignores the "efficiency of labor," which is fast approaching the efficiency of a certain famous pump; the test engineer reported "The efficiency of this pump is so low that it may be neglected." Indices of this type make no allowance for relative efficiency of construction plant or job management, of competitive conditions, or of the effects of protracted periods of construction such as we have today, when it takes three years to do a job that before World War II could be completed in less than one. The index, assuming a uniform ratio of skilled to unskilled labor, overlooks the fact that unskilled labor is gradually being crowded out of the construction industry as the skilled crafts insist on taking over more and more of the work that requires no skill. Such indices take no account of "feather bedding" and other cost burdens imposed by the construction crafts, so that in many respects this type of index presents a distorted picture. It fails to reflect the real ratio of costs today with those preceding World War I.

Our own index for Electric Plant, has the same shortcomings, in that it does not show completely the heights to which construction costs have risen.

In the development of this index, 14 electric light and power company properties located in 12 states were analyzed to obtain a composite weighting of the various accounts making up the properties. Accordingly, it may be assumed that an average or typical 1914 electric property was the basis for the development with no attempt to reflect improvements in the art which might have the effect of materially changing the component weightings.

The underlying cost data, consisting of 38 components making up the composite total property, have been obtained from a number of reliable sources and all are fairly representative of aver-

age costs which would be incurred in this particular area in a given year.

It should be understood that the index has not been prepared either for general application or for application to any particular property, without suitable adjustments. As it stands, it is intended to serve only as a general guide and not as a basis upon which to arrive at a final determination in any specific case. Moreover, modifications of the index have been made from time to time, even for previous years, whenever more reliable information, previously unavailable has come into our possession.

In situations where it is required to reach a reliable determination for a specific property, adjustments must be made to bring the index into harmony with material prices and labor rates in the territory involved and with the composite chararcteristics of the particular property in question. It should also be pointed out that the index does not purport to reflect the abnormalities in recent wartime costs because they do not give effect to the influence of lessened productivity of labor or to the increase in certain material costs on which fabrication has permitted greater price increases than were allowed for the basic material prices used in developing the index numbers.

This index, then, has two defects, if taken as a measure of the situation in which we now find ourselves. It does not reflect the declining efficiency of labor, and it assumes the reproduction of obsolete plant, which under no circumstances would be reproduced today. An effort has been made, therefore, to develop an index which would reflect both labor efficiency and technological advances. This was not feasible for whole systems, but it appeared that a reasonably sound index for steam power plants might be prepared from the cost records in our own office, in view of the fact that we have been constructing steam power stations for nearly 60 years, and we have complete cost data for at least 45 years covering plants of all sizes and types, erected in all parts of the country. During that time we have consistently, for any 5 or 10 year period, constructed about 10 per cent of the public utility steam generating plants in the United States. Our cost records are sufficiently complete, and sufficiently uniform, to serve as a basis of comparison for such construction since 1902.

Steam Production Plant normally constitutes more than 40 per cent of total Electric Plant cost in a system where all power is steam generated. Our index, corresponding to that for combined Electric Plant shown in Fig. 3 roughly parallels the latter but reaches a considerably higher level as shown in Fig. 4.

Adjusting the Index

The Turner Index of Building Cost, which is adjusted to allow for efficiency of labor and other realistic items now stands about 25 per cent higher than the Engineering News Record Index of Building Costs. Labor is a less important factor in power plant than in general building construction, but it is certain that a similar correction of this index would carry it above 400, today. This does not mean that it would cost four times as much to build a power plant of given capacity now as it would have cost to build a plant of the same capacity before World War I. The cost of building would be more per cubic foot, but larger units and higher rates of heat transfer would reduce the building volume required. Steam generating equipment would cost more per square foot of heating surface, but the modern boiler would generate more steam per square foot, while the modern turbine would require less steam to produce its rated capacity. Higher speeds helped to hold down the rising cost of prime movers. Our adjusted index, shown by the heavier line on Fig. 4, purports to reflect such advances in the art of generating power by steam. The difference between this line and the unadjusted index is a measure of net reduction in steam power plant cost effected by advances in the art, in spite of the adverse effects of declining efficiency of labor.

This adjusted index is the weighted average cost, per unit of capacity, of steam power plants which Stone & Webster had under construction during each of the last 45 years, and for which comparable cost records are available, converted to an index with costs in the year 1914 taken as 100.

At the beginning of the century when we were installing 500 kw engine generators with 200 hp hand-fired boilers, the unit cost of power stations was high —even a little higher than it is today. With the advent of steam turbines, overfired and then underfired stokers, costs come down, reaching their all time low at about the time we have chosen as our base, 1914.

Costs rose again with prices and wages during and after World War I, but not as fast as the unadjusted index. Following that war, the unadjusted index remains at a high elevation, but the adjusted index falls as larger and larger units, and mounting rates of heat transfer effected substantial savings in the relative cost of plant. After 1930, the trend begins to parallel the unadjusted index. The average size of units installed is still increasing although the maximum for any individual installation was reached before that date. The subsequent savings in structural cost were of a minor nature. More equipment was installed out of doors. Cheaper building materials were used in many instances, providing functional structures rather than architectural monuments. Hydrogen cooling enabled us to get the desired generating capacity with less iron and copper. These savings barely offset increased expenditures for higher pressures and temperatures, and the effects of decreased productivity of constructing labor, so that the net gain in cost of Steam Production Plant has been very little since 1930.

Within the past six months, the adjusted index exceeded the peak it had established following World War I, and while it has not yet reached the levels of 1902 when we were installing 500 kw engine driven generators, it appears to be on its way to an all time high. In any event, so far as plant cost is concerned, all the technological advances of the last 25 years have been wiped out by mounting wages and prices. If there were any indication that we are at or near a second postwar peak, there would be no cause for despair. A kilowatt of steam capacity installed in 1947 costs more than twice as much as a similar unit installed in 1914, but it is easily worth that premium. In the first place, the owner may expect to get more than 50 per cent more use out of it, due to the higher load factors now prevailing. The 1947 plant will produce 60 per cent more power for every ton of coal burned and twice as much power per man hour of operating labor. Perhaps we can afford to pay what capacity costs today, but can we afford to pay what it will cost tomorrow?

Future Considerations

Looking into the future, we seem to have reached the period of diminishing returns in regard to the designing engi-

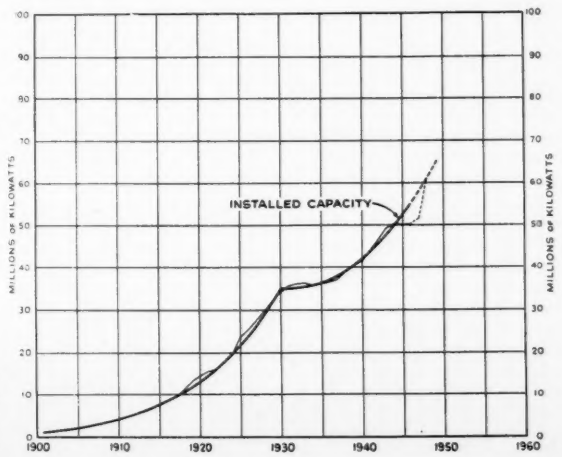


Fig. 5. Long Term Trend of Installed Capacity for Generation of Electric Power in the United States

neer's ability to lower costs. Further reductions must come from some sacrifice of convenience and flexibility on the part of the operator. We do not presently aspire to larger units, but improved methods of combustion may further reduce cost of steam generating equipment and housing. Neither do we aspire to higher generator speeds, except for the largest units. Improvements in manufacturing methods and genuine standardization may help to reduce equipment costs. New and cheaper construction materials may be developed. One virgin field for technological development is the construction industry, itself. The few improvements that have been made in the art of building have been largely vetoed by union regulations. We may even hope for improvement in the productivity of construction labor. Some day, somehow, our entire nation must learn that our boasted standard of living springs neither from high prices nor high wages, but from high production. When this lesson is learned, construction trades will allow engineers to devise methods and machinery which will multiply the individual worker's output as it has been multiplied in the power plant and in the factory. Like his brother in the production field, he will have more employment. He will earn more with less effort. By producing more, he will help to turn this curve downward. This we may hope for some day, but not tomorrow.

It would be helpful if we could predict, from a graph like this, where we are going and when we will get there, but all it tells is where we are and how we got here. Remember that power plants now being authorized will reach their peak of construction activity at the end of 1949. Looking at a chart like this, what would one estimate the plant will cost? If history repeats itself, we may have been over another postwar peak and costs will be coming down. But down from where? We may assume that we shall go over a hump and reach a protracted "plateau" as in 1925 to 1935, but will we, and if so, will the plateau be any lower than where we now are? While the title assigned to this paper requires discussion of not only cost "trends," but their "implications," the answers to questions like these are beyond the scope of a mere implication.

Back in 1914, to which we refer as our base year, we still accepted Adam Smith and John Stuart Mill as authorities on prices. They would have told us that, as a long time trend "in a state of freedom," our eventual prices would bear some relation to gold value of our money,[2] that is, we could expect our future "plateau" to be at least 60 per cent higher than its prewar elevation, or about where we were at the end of 1946. Of course, we are not economically "in a state of freedom," and Messrs. Smith and Mill have been discredited by a series of 5 to 4 decisions, so we do not have even the gold value of the dollar as a standard for prognostication. We might hazard a guess, however, that there may be some residuum of validity in the old "Principles of Political Economy" and that our future efforts to reduce costs by engineering improvement will start from a postwar level of at least 200 compared with the prewar 130. If this is true, we may regard any improvement in design which reduces the capital cost of plant as something of permanent value and not a temporary expedient to meet present conditions.

It would be comforting if we could postpone our investment in Electric Plant until we see what the future brings forth. The miller and shoemaker may be able to wait and see what is going to happen, but not the public utility. Already we are running a race with time that we are by no means sure of winning. We have not caught up with where we were going back in 1930. We have not caught up, we are not even progressing as fast as we were at that time and the years immediately preceding it.

Fig. 5 shows the growth of generating capacity of electric systems in the United States since the beginning of the century. The graph shows a very smooth progress from 1,200,000 kw in 1902 to 34,000,000 kw in 1930. The continuity was broken by the great depression, but again, neglecting some irregularity due to wartime construction restrictions, we seem to be making a smooth progression, passing the 50,000,000 kw mark in 1944 and we have plants under construction that will bring us to 60,000,000 kw in 1949, if our construction schedules are maintained. The point of the graph is this: In spite of the fact that we have more generating equipment on order than at any previous time in the history of the industry, we are not building as fast, comparatively, as we were in the 1920s. The slope of the first curve on this graph is greater than the second. Even if we realize our construction schedules, the capacity available in 1949 will not give us what we regarded before the war as essential reserve, unless there is a material recession in the demand for power. With the same factors that are sky-rocketing construction costs may induce such a recession, it is unlikely to be of sufficient magnitude to allow power plant construction to catch up with the demand for several years. Whether we like it or not, high cost or higher cost, the public utilities must keep on building.

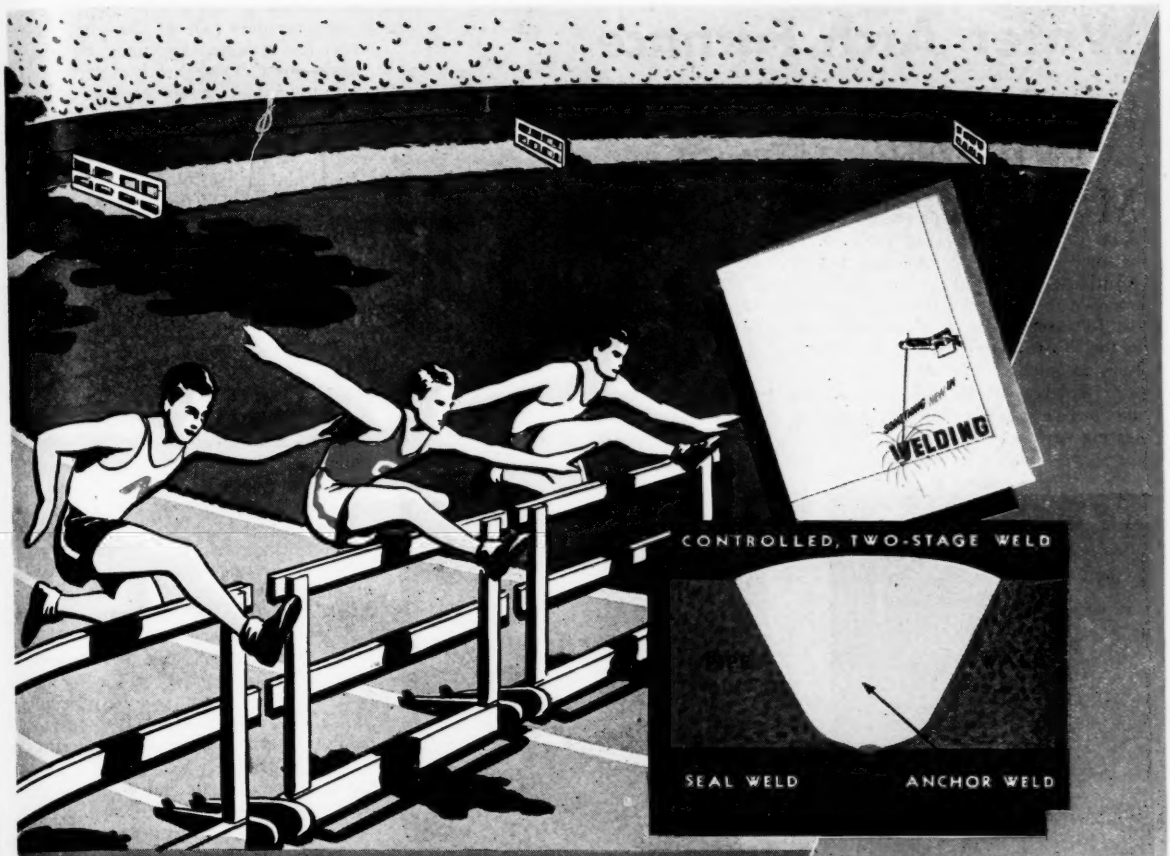
The long term outlook is equally demanding. The high labor costs which concern us in construction work and power generation are universal throughout industry. Labor saving devices are in demand, and such devices require power. Higher earnings of the wage earner result in more completely electrified homes. Some day we shall have the "adequate housing" we are dreaming about, with all that means in domestic consumption of power. On top of this, electrically, we are not the world leaders we are generally supposed to be. The per capita consumption of power is 115 per cent higher in Canada than in the United States, and before World War II there were at least four European countries who outranked us in this respect, including the tiny Duchy of Luxemburg. There is every evidence that we must keep on building, now and for a long time to come.

On the other hand, we should not continue construction blindly in complete disregard of present costs. If we can not postpone the building of essential capacity, we may at least be able to postpone some desirable but nevertheless deferrable items, even at some temporary increase in production expense. Auxiliary buildings, warehouses, shop facilities, permanent office space and other adjuncts might well be postponed until there is less demand for construction materials and labor for other purposes. Even for essential plant, many features should be carefully scrutinized to avoid any unnecessary costs. If less expensive boilers can be installed at more expense for auxiliary power, or substantial amounts can be saved in the construction of condensing water supply systems at the expense of higher pumping costs, let us weigh these factors with the utmost care. We should consider some practical matters in addition to the theoretical minimum return on optional investment. In 1932 we saw the load factor on our steam power plants drop to less than 25 per cent, and it is conceivable that this may happen again. Let us spend what we must spend for capacity and reliability, but scrutinize very carefully all optional expenditures for marginal savings in production expense.

Substantial savings can be made at some sacrifice of convenience and flexibility by installing a single boiler for each turbine generator and by omitting cross connections between boilers and turbines, that is, by adopting a complete unit system. We should consider whether the inconvenience of more out-of-door construction is not justified at present cost levels; after all, most of our so-called "out-of-door" plants are fairly well housed. Particularly, we should not be thrown into a panic by present fuel prices, and start a mad race for thermal efficiency at the expense of a reasonable balance between capital investment and long term production costs. Fuel has been high before, as shown in Fig. 1, but it did not stay high. Even if present fuel prices should prove permanent, let us not forget that fuel belongs in the energy component of our rate schedules, while construction costs are part of the demand charge. It is the demand charge which may cause us most concern in the years to come.

[2] "Let it therefore be remembered—that a general rise or a general fall of values is a contradiction; and that a general fall of prices is merely tantamount to an alteration in the value of money—." John Stuart Mill, "Principles of Political Economy," Book III, Ch. 1.

"The value of money then, conforms permanently, and in a state of freedom almost immediately to the value of the metal of which it is made." Ibid, Book III, Ch. 9.



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MANY INSTALLATIONS of Scotch marine boilers for small and medium capacity have given good service in small industrial, commercial and institutional power and heating plants. To improve their performance still further, the Johanson water arch furnace shown in the illustrations has been developed. It is designed to provide:

1. A large combustion chamber for the furnace gases before they enter the heating surfaces;
2. Improved water circulation of the boiler;
3. Additional water heating surface in the furnace;

The Scotch marine boiler has a definite place in, and offers a number of advantages for, various types of small and moderate capacity installations. It requires low headroom and a minimum of boiler setting. However, if it is fired with a stoker installed directly in the Morrison furnace of the boiler, the stoker occupies part of the combustion space and reduces its volume, sometimes nearly one-half, so that it is often difficult to obtain rated capacity. Also, stoker maintenance has been high in some cases. Fired with oil, Scotch boilers in many cases have been able to attain about 150 per cent of rating. But to do this, much excess air must be used, causing low CO_2, high flue gas temperatures, and very hot boiler fronts.

To overcome this situation, the water-arch furnace shown here is designed as an extension furnace to fit over the openings of one or more Morrison furnaces in the Scotch marine boiler as shown in Figs. 1 and 3. It has been applied to the furnace of a standard double-pass fire-tube boiler as shown in Fig. 2, and to cross-tube water-tube boilers. It is, in effect, a water-cooled Dutch oven furnace. Its design is patented, and is shown in Figs. 2 and 3.

The furnace, as shown in Figs. 2 and 3, consists of water wall tubes connecting into two lower mud drums and running to one center top circulating drum. These drums are connected to the boiler with circulating pipe lines, to create a complete circulating system of water in the boiler. The furnace tubes are then covered with firebrick, which are completely supported by the waterwall tubes. This construction is designed for very low upkeep. Construction, design and shape of the water-arch furnace are intended to provide full access for cleaning to any of the tubes and front flue doors of the boiler. The furnace may be designed for any desired height or width, to provide a large combustion chamber.

This furnace, stoker fired, will, it is claimed, obtain as high as 200 per cent rating on the Scotch marine boiler and eliminate replacement of grate parts, operate without smoke, with gases leaving the boiler from 200 to 300 deg lower than with the Morrison furnaces alone. Fired by oil burner, it is claimed to completely eliminate back pressure in the furnace, front of furnace will be cool and 200 per cent of rating may be

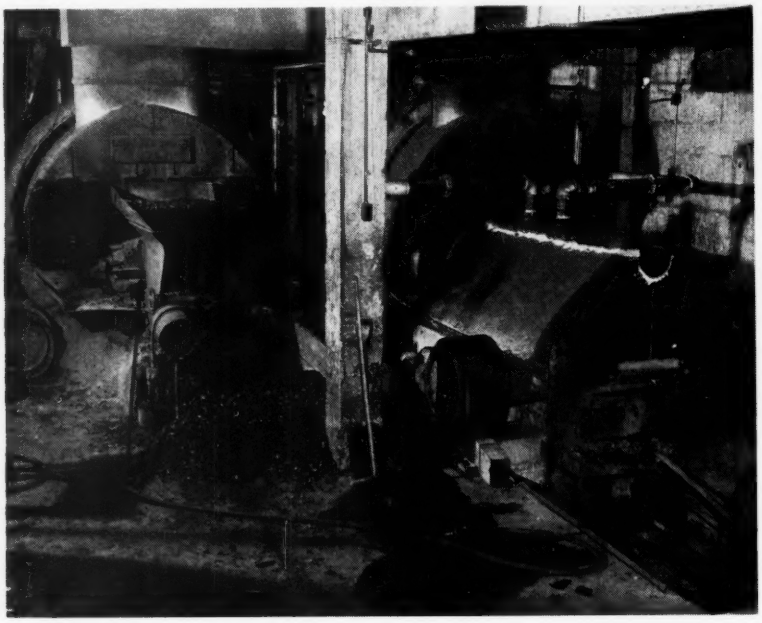


Fig. 1. One 125-hp single-furnace Scotch marine boiler at right, to which water-arch furnace was added, now carries total load, with same stoker, which two boilers with stokers inside Morrison furnaces could not carry

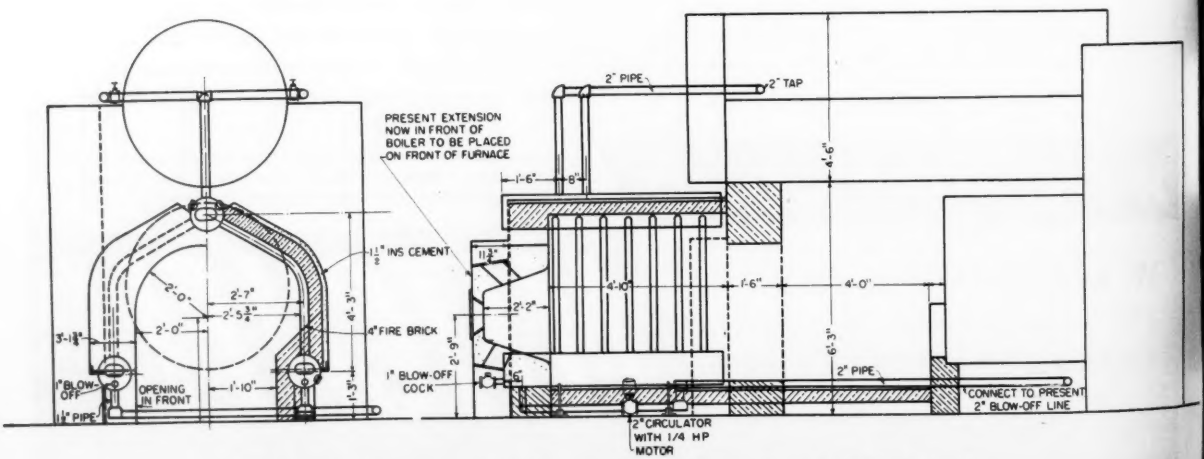
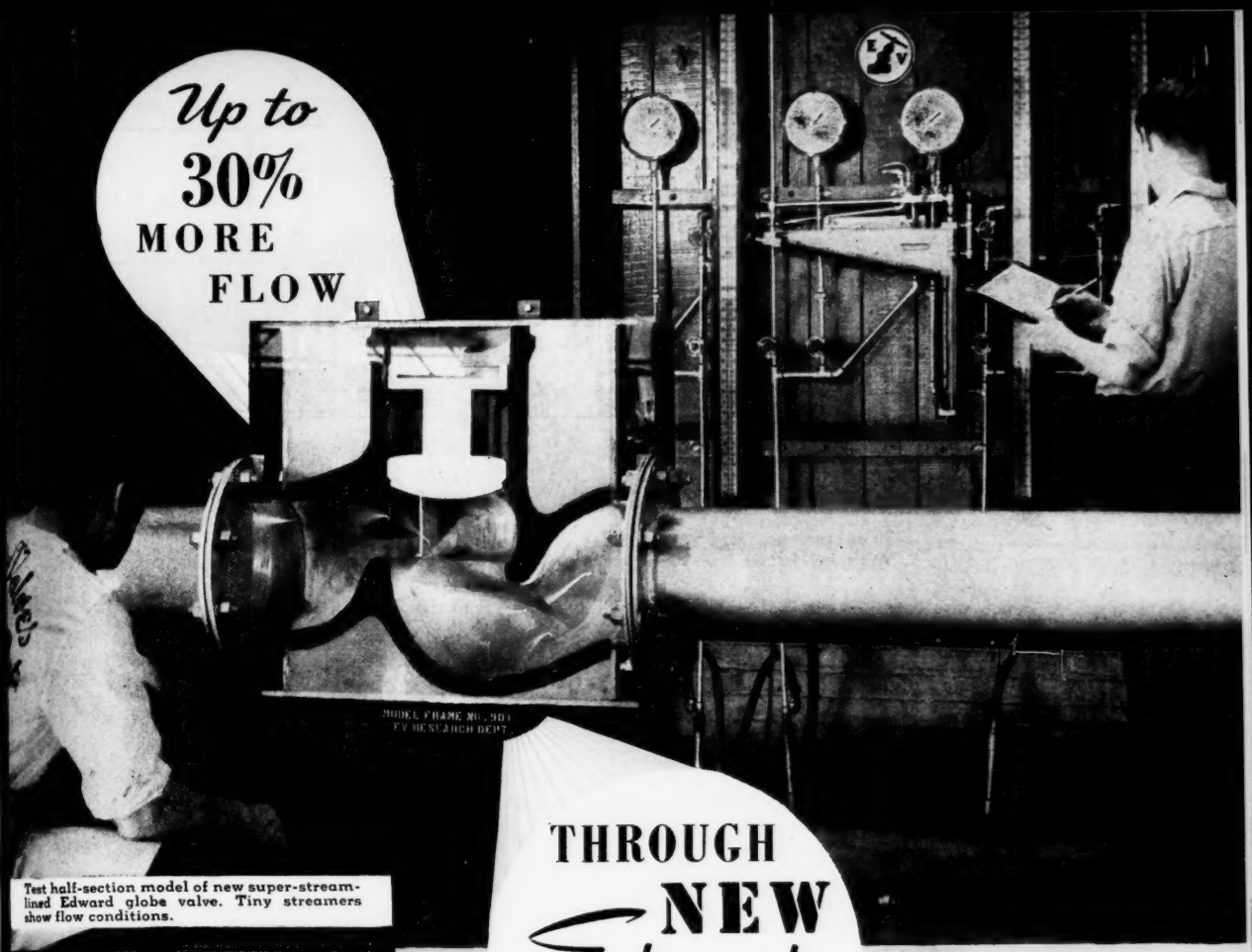

PRESENT EXTENSION NOW IN FRONT OF BOILER TO BE PLACED ON FRONT OF FURNACE
2" PIPE
2" TAP
1½" INS CEMENT
4" FIRE BRICK
1" BLOW-OFF COCK
OPENING IN FRONT
1" BLOW-OFF
1½" PIPE
2" PIPE
CONNECT TO PRESENT 2" BLOW-OFF LINE
2" CIRCULATOR WITH 1/4 HP MOTOR

Fig. 2. Water-arch furnace installed on oil-fired double-pass fire tube boiler in laundry

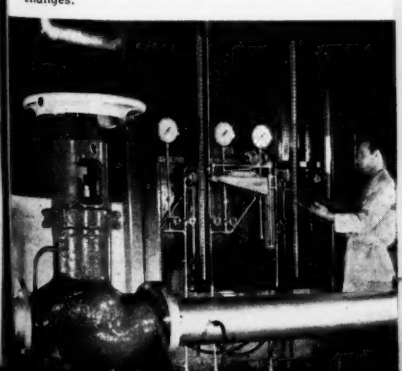
Up to 30% MORE FLOW THROUGH NEW Edward VALVE DESIGNS



Test half-section model of new super-streamlined Edward globe valve. Tiny streamers show flow conditions.

Above—Casts of core sections of model guide pattern design for new high flow rate Edward valves.

Below—Finished 10 in. Fig. 4006 Edward globe non-return valve with Equalizer under test. Flow meters and gages record pressure changes.



This is the embryo stage of a new Edward Valve—a full scale half-section model. It's hooked up to a flow and pressure drop recording test line, with half the piping at each end of the valve model sectioned and sealed off. Pins bearing yarn streamers are stuck into the plastic, which is frozen in the desired contours and sealed off with a thick transparent plate.

When an air current is blown through the model, *you SEE what goes on.* You can *see* (and record) where turbulence steals pressure. You can *see* where inside contours may need reshaping to provide ideal flow and minimum loss of pressure.

From this model, core sections of plaster and wood are made—the first step in development of patterns for *valves designed from flow tests.*

Most important of all, you see clearly why Edward Flow Testing produces valves that increase flow by as much as 30% compared to the accepted performance of similar valves and, of course, greatly decrease wear-producing turbulence.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

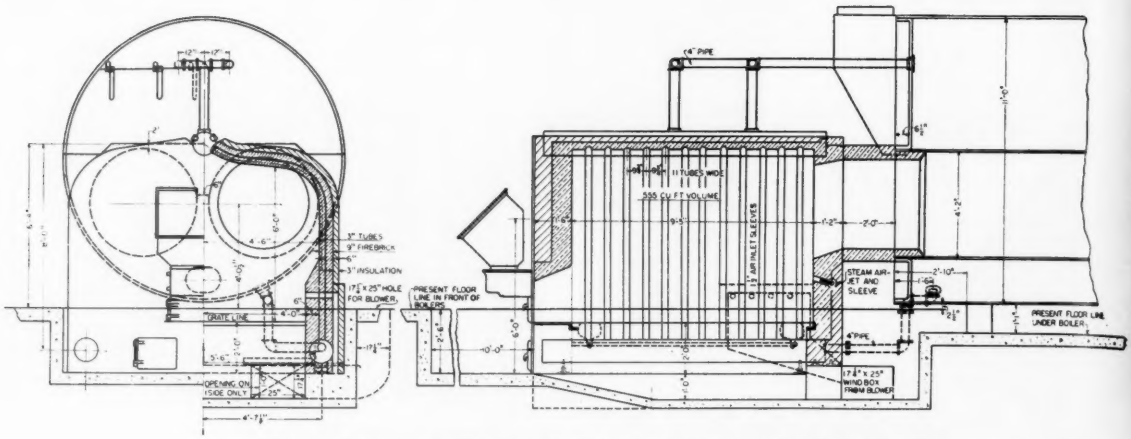


Fig. 3. Water-arch furnace installed for stoker firing on double-furnace Scotch marine boiler

obtained on boiler with gases leaving boiler from 200 to 300 deg lower.

In one recent installation, at Northwestern Military and Naval Academy, Lake Geneva, Wisc. there were two 125-hp Scotch marine boilers fired by stokers inside the Morrison furnaces; with these, it was impossible to carry the load or pressure with both boilers in use and stokers operated continuously.

The water-arch furnace was installed on one boiler, as shown in Fig. 1, and this boiler now carries the total load, the stoker working intermittently, making no smoke and with a saving in fuel. The same stoker was installed in the new furnace and saves the owners about $1500 each year, which they formerly spent on repairs for stokers alone, plus the saving on coal, which will make the furnace pay for itself in 3 years.

Another installation at the American Home Laundry, Hammond, Ind., shown in Fig. 2, was an oil burning job, which was unable to produce enough steam to operate the laundry. After the water-arch furnace was installed, using the same oil burner in the front of the new furnace, the boiler now furnishes more steam than required by the laundry.

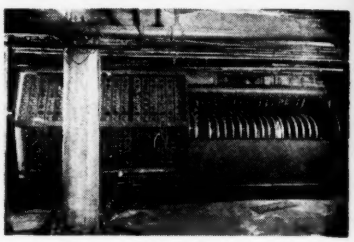


Fig. 4. Furnace installed on front of low-head-room cross-tube boiler

ASME Semi-Annual Meeting at Chicago

From June 15 to 19 inclusive, the Chicago Section was host to the ASME members from all sections of the country. Engineers' interests in management, economics, the humanities were stressed in general sessions. Technical problems and scientific developments discussed in many sessions. Advancements in gas turbine power and nuclear energy given attention. E. G. Bailey, vice-president of B. & W. Co., nominated to head ASME in 1948

EVEN the weather man favored those who attended the Semi-Annual Meeting of the American Society of Mechanical Engineers who gathered at the Stevens Hotel in Chicago on June 15-19. All told some 1500 members and friends attended portions of the meetings which started Sunday afternoon with a trip along Chicago's North Shore Drive in cars provided by members of the Chicago Section, stopping at the Baha'i Temple in Wilmette recognized as one of the most interesting buildings in the world both from an architectural and engineering standpoint, then proceeding to the Michigan Shores Club in Wilmette for an evening's entertainment of cocktails, dinner, music and motion pictures.

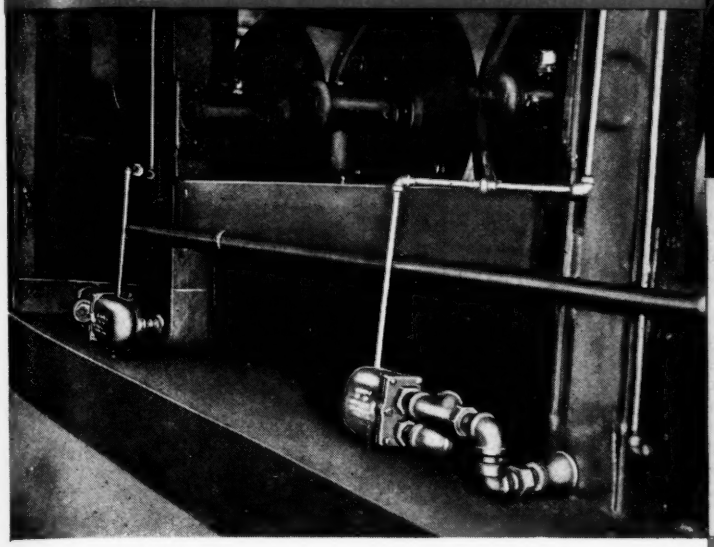
At luncheon and dinner meetings, in addition to social entertainment, topics of general interest were discussed by men prominent in their particular fields. President E. W. O'Brien chose as the topic of his address "Broader Vistas" in which he analyzed the results of a questionnaire recently circulated among members of the Society which dealt with the attitude of engineers regarding collective bargaining and other activities having to do with the economic standing of engineers. It was startling to many of the older engineers to find the definite trend toward socialization among the younger group of engineering college graduates.

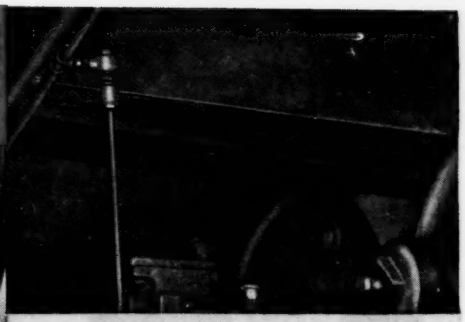
Charles E. Wilson, president of General Motors, at a dinner meeting spoke at length on the subject, "The Great Delusion—Where Marx Went Wrong," to point out how our American concept of a free society is being improperly challenged by those who subscribe to Marxism, not only abroad, but even in the United States. "Through propaganda," he said, "and fifth column activities, the thinking of some of our fellow citizens has been warped to the point where they question our American concept of a free society. The great delusion of those who subscribe to Marxism is that a people will be happier and more prosperous in some communistic or socialistic form of society based on Marxist philosophy than they can or will be in a free society based on fundamental principles recognized by the founders of our Republic."

Another stimulating address was that given by L. J. Fletcher, director of training and community relations of the Caterpillar Tractor Co., who outlined a program of activities whereby better understanding and more harmonious relations can be built up among employers, employes and the people in the community.

Robert R. Wason, president of Manning, Maxwell & Moore, Inc., and chairman of the board of National Association of Manufacturers in his address "Engineering Waits for Economics" stated that "Too Few Americans recognize the statism that was created and the liberties that were lost through

Dyeing AND *Drying*

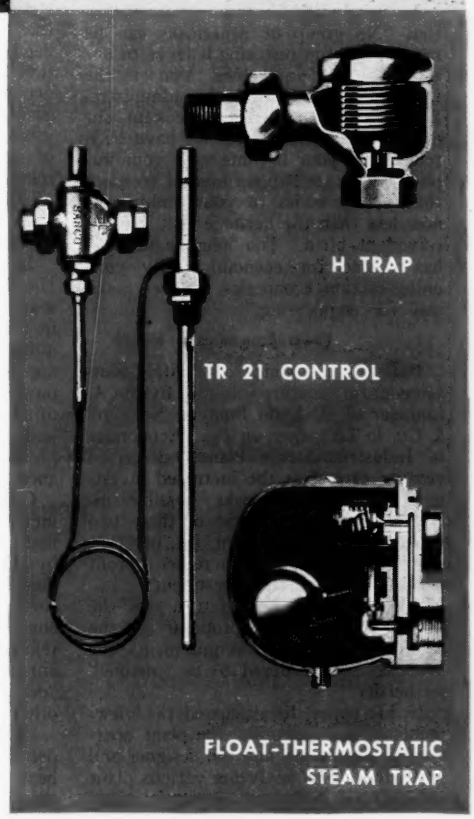




WITH SARCO

STEAM

TRAPS AND CONTROL



Rotating cylinders as used in the paper and textile industries accumulate heavy condensate if not properly drained and vented. If any cylinder lags behind others—the material sags on one side, stretches until it breaks on the other. Hours are lost in starting up again.

Sarco FT Steam Traps with H Air Vents at the top settled this problem in a large textile plant in Brooklyn. Sarco TR 21 Temperature Controls are used on the dye vats which immediately precede the drying operation.

This job was engineered by the local Sarco representative. The cost was negligible compared to the results obtained.

Adequate removal of condensate and air, and satisfactory temperature control can provide that added margin of profit in any industry using steam. The combined advantages of faster work, fewer stoppages and rejects and less fuel will work for you every hour.

Sarco products work as a team. The right combination costs less in the first place—lasts longer—serves best.

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E. G. Bailey, nominated to hold office of national president of ASME in 1948

Government controls in the past years, peace and war. . . . During fourteen years this nation was conquered by the security ideologies of Europe as certainly as if it had been conquered by the guns of the communists, nazis and fascists."

In concluding his address he stated that "No group of Americans can be more helpful in restoring balance to our economy than yourselves. You are the inventors, the creators, the administrators and engineers that have kept our nation great. Your liberties have been reduced in your lifetime with your implicit consent. The heritage of freedom that you pass on to your children is now less than the heritage that you received at birth. Too long engineering has waited for economics. By your united action economics can yet make way for engineering."

Power Economics

Defining economics as thrifty management of venture capital, Byron A. Lininger of E. I. du Pont de Nemours & Co. in his paper on the "Economics of Industrial Steam Plants" described venture capital as the increased investment required to make possible increased profit. The ratio of these two factors is per cent return, i.e., per cent return is equal to increased profit divided by increased investment.

"When the per cent return test" he said, "is applied to a proposal and the result meets minimum requirements, the proposal is considered to be 'justified' financially."

In his paper, he discussed the viewpoints of the executive, the plant operator or supervisor, and the designer and presented tables analyzing various plant expenditures from an economic viewpoint.

Edwin H. Krieg of the American Gas and Electric Corp. discussed "Economics in Power Plant Design" pointing out that the primary objective of the designer is to secure the highest overall return on the investment in the plant. This means attempts to attain the lowest fixed charges through low first cost and high availability, and lowest operating charges through low fuel, labor and maintenance costs. The author presented data regarding some specific cases of plant economies with which he is familiar and went into considerable detail to show how the economies were effected.

In the discussion of this paper Sabin Crocker of The Detroit Edison Co. discussed similar measures for reducing costs or increasing availability employed by his company and presented a table giving, among other items, the annual heat rate of the Detroit Edison System from 1924 to date and estimated to 1950. The table shows a reduction from 14,000 Btu per net kwhr in 1924, to 11,300 in 1947, and to 10,500 in 1950.

As a progress report of an investigation being carried on by the U. S. Bureau of Mines, J. F. Barkley, L. R. Burdick and A. A. Berk presented "Test Data on Gas-Side Sulphate-Type Deposits on Tubes Beyond the Boiler Furnace" as a paper in which the various tests were described and the results tabulated. The authors described an improved and satisfactory method of analyzing products of combustion for SO_2 and SO_3 content and point to the complexity of the action resulting in the accumulation of the sulfate-type deposits on the tubes. Among the factors cited which affect the quantity of deposits were temperatures of tubes and gases, quantity, size and chemical analysis of the fly ash, the relative amount of burning of SO_2 and SO_3, and the relative saturation of the moisture and of the sulfurous gases which depends upon the CO_2 carried and the amount of sulfur coming from the coal.

In addressing the fuels luncheon, Dr. Harold J Rose of Bituminous Coal Research, Inc., stated that the coal reserves in this country can supply all U. S. requirements for the next 1500 yr. This applies to requirements for heat, light, power, transportation and the smelting of metals, all liquid and gaseous fuels, and most synthetic chemicals, at the present rate of consumption with allowance for conversion efficiencies.

Coal research is today being given increased support by the coal industry itself, by federal and state governments, by the petroleum, gas and chemical industries and by equipment manufacturers. Expenditures on research and engineering development work closely related to coal are $15,000,000 or more annually in this country, with large additional expenditures in England and other countries.

"Through experience it has been definitely proved since 1935 that the heat pump will work and that it is practical" said E. B. Penrod of the University of Kentucky who outlined the history of the heat pump from its first suggestion by Lord Calvin in 1852 to present practice. Performance is being constantly improved with domestic heat-pump systems reported still in the experimental stage. With electricity available at a cost of 1 cent per kwhr the heat pump compares favorably in cost of heating with gas or oil.

Engineers in charge of turbine operation were given some very helpful information by J. C. Falkner, R. S. Williams and R. H. Hare, all of Consolidated Edison Co. in a paper describing the "Quick Starting of High Pressure Steam Turbine Units." The method described reduces the thermal "start-up" stresses in the turbines and boilers, reduces the starting fuel losses, reduces the personnel required and increases the available reserve factor as compared with the conventional "start-up" methods.

In essence the method consists simply of admitting steam to the turbine at a temperature corresponding to that of the main parts of the turbine, such as the valve chest, heavy flange joints, top and bottom of casing, etc., after a "shut-down" period up to ten hours. The paper described the investigations that were carried on to see what could be accomplished in a way that would reduce the heat stresses in both turbines and boilers to a minimum and to reduce the starting cost. Complete directions were given for the quick start-up procedure and the authors reported an appreciable saving in starting costs. The method will also be used at such times as either boilers or turbines must be taken off the line for minor maintenance.

In the field of heat transfer, several sessions devoted time to detailed discussion of such subjects as: Heat Transfer by Free Convection From Heated Vertical Surfaces to Liquids; Heat Transfer to Water Boiling Under Pressure; Temperature Distribution in Some Simple Boilers Developing or Absorbing Heat at a Linear Function of Temperature; A Review of Available Data on the Dynamic Viscosity of Water and Superheated Steam; and An Investigation of the Variation in Heat

Robert R. Wason, president of Manning, Maxwell and Moore, Inc., addressing ASME on the subject Engineering Waits for Economics

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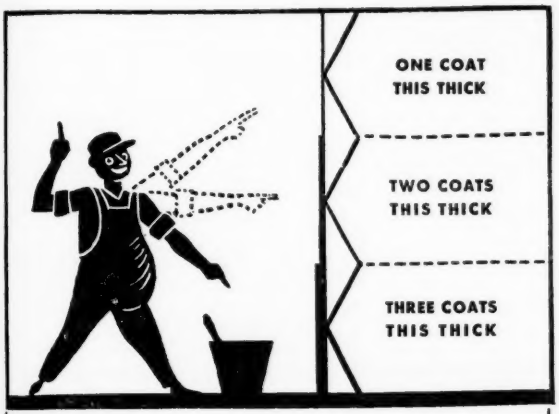

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a time proved seal against corrosion . . . refined coal tar—as a stable dispersion in water—forms a thick plastic coating for the protection of metal, concrete or masonry surfaces.

AND THE COAT IS THICK . . .

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WESTFIELD, NEW JERSEY

Dr. Harold J. Rose of Bituminous Coal Research, Inc., Julian E. Tobey of Fairmount Coal Bureau, and E. W. O'Brien, president of ASME

Absorption in a Pulverized Coal-Fired Water-Cooled Steam-Boiler Furnace.

Investigators in the field of atomic energy reported their belief that this new form of energy for practical power production devolves upon the solution of many engineering problems which must be solved by the engineer and the nuclear physicist, working together. Dr. O. C. Nier of the University of Minnesota pointed out that the construction of atomic reactors requires materials whose properties are largely unknown under the operating conditions. New materials will have to be developed so that the greatest efficiency of operation will be achieved. One of the greatest problems encountered is that of the heavy shield that must be provided against the death dealing emanations from the atomic power plant. Another problem is the removal of waste products from any practical atomic furnace.

The oil and gas power sessions held at this meeting were devoted principally to the technical problems of the aviation field. The gas turbine, however, came in for its share of attention. "Development and Testing of a Gas Turbine Combustor," was the title of a paper presented by A. E. Hershey of Westinghouse Electric Corp. He described the test equipment and instrumentation required to evaluate gas turbine combustor performance. He also discussed operating conditions which would duplicate actual operation in the turbine unit and considered the performance of a combustor designed to operate on residual fuel oil.

J. R. Hawkins, Jr., of the Union Electric Co. in a paper entitled, "The Modern Gas Turbine in the Industrial Power Plant" called attention to the growing recent trend in some industries toward a greater use of power and a lesser use of steam and pointed out that it may be found economically advantageous to use gas turbines with waste heat boilers utilizing turbine exhaust.

Gas turbine applications to railway locomotives were discussed in two papers. One dealt with the design features of a 4800 hp mobile gas turbine plant and was delivered by Alan Howard of General Electric Co., the other, presented by John I. Yellott and Charles F. Cottcamp, both of the Locomotive Development Committee, noted the probable applications of this type of power generator, analyzed the coal burning system under development and presented test data on a wide variety of coals used in the coal atomizer.

Development of a process for the production of char from coking bituminous coal which will make this product desirable for steam and power generating stations was described by A. D. Singh of Singh Co. and L. J. Kane with the Bureau of Mines, both formerly with the Institute of Gas Technology. It was pointed out that power char has certain advantages over coal as fuel some of which are: power cost of pulverizing is 20 per cent less, equipment maintenance lower, higher rates of combustion obtainable, burns with shorter flame, increased furnace capacity, lower hydrogen content and reduced surface moisture results in fuel saving of 4 to 5 per cent, more free flowing in pulverized form, and danger of spontaneous combustion almost entirely eliminated.

Officers Nominated

The Nominating Committee announced its selection of new officers for 1948 to be chosen by letter ballot of the Society membership, the election closing September 23.

For president: E. G. Bailey, New York, vice president of The Babcock and Wilcox Co. Mr. Bailey is an inventor in the combustion field, holding more than 100 U. S. patents. He is an authority on fuels, combustion, and power developments. His home is in Easton, Pa.

Regional vice presidents: Frank M. Gunby, associate of Charles T. Main, Inc., 201 Devonshire St., Boston—Region 1. Paul B. Eaton, head of the mechanical engineering department of Lafayette College, Easton, Pa.—Region 3. Thomas E. Purcell, general superintendent of power stations, Duquesne Light Co., Pittsburgh, Pa.—Region 5. J. Calvin Brown, head of the firm of J. Calvin Brown, 704 South Spring St., Los Angeles—Region 7.

Directors-at-Large: J. B. Armitage, vice president in charge of engineering, Kearney and Trecker Corp., Milwaukee. A. L. Penniman, general superintendent of operations, Consolidated Gas, Electric Light and Power Co., Baltimore. William M. Sheehan, vice president of General Steel Castings Corp., Eddystone, Pa.

MINIATURE ELECTRONIC TUBES

THE USE OF miniature electronic tubes, now being built by the hundreds of thousands, will make possible more compact radio and television receivers. Approximately an inch high and half an inch thick, these new-type tubes weigh less than an ounce, and require less than one-fourth the space of the tubes they are replacing.

Because of their light weight and small size, miniature tubes are expected to prove of special value in aircraft communication equipment. Engineers point out that in about five years a large transport plane will probably carry more than 600 electronic tubes. At the present size, they would weigh 225 lb. The same number of miniatures weighs only 37 lb, and their size permits installation of electronic equipment into considerably smaller space than is required with sets using conventional tubes.

In addition to the several advantages coincident within their size and weight, the new tubes have inherent operational advantages, such as the reduction of capacitance effects, which makes the tubes more responsive at the higher frequencies.

G. E. Review

ENGINEERS EXPERIMENT WITH SOLAR-HEAT FOR ALL-CLIMATE DOMESTIC HEATING

"MASSACHUSETTS INSTITUTE of Technology engineers are trying to capture enough heat from solar radiation to warm the average house in any kind of climate and, eventually, to provide industrial power. There is a "heat-trap" in a 1-story structure on the Cambridge bank of the Charles River. The bait is composed of ordinary tin cans filled with salt and water. The building has celotex walls and refrigerator doors on three sides, and double-paned windows on the south side to catch the sun's rays.

The heat-trap is dependent upon stacks of 2-quart and gallon-sized tin cans inside the south wall of glazed glass. As the heat rays penetrate the glass, they are transmitted to the metal cans and absorbed by the water and melting salt inside. The liquid holds the heat in storage for re-radiation into the rooms long after the sun has gone down. There are seven compartments in the 50 by 14-foot structure.

A special solar energy committee of the institute will make several simultaneous tests of glass thicknesses, can sizes, and the types of chemicals or liquid capable of sponging up the sun's heat. The committee will attempt to prove that the conventional domestic heating system can be eliminated. The research is backed by a $650,000 gift from Godfrey C. Cabot of Boston."

Engineering News Record

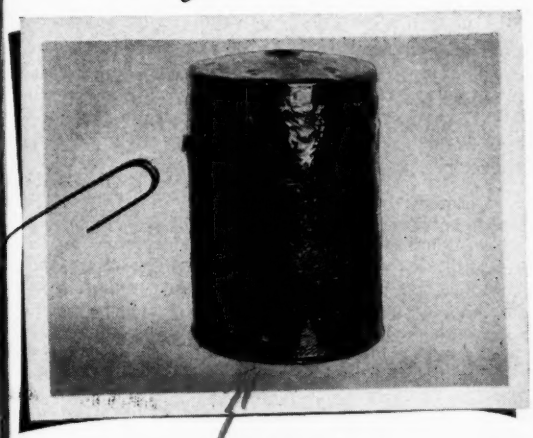
In 1800 there were only 335 profit-seeking corporations in the United States, reports a Twentieth Century Fund survey. Turnpike, bridge and canal companies comprised two thirds of the total, while banks and insurance companies made up the other third. Manufacturing was represented by only six corporations.

A Twentieth Century Fund survey reports that our bituminous coal reserves are adequate for over a thousand years and our anthracite reserves for over 175 years.

A Twentieth Century Fund survey reports that about 40 per cent of the communities in the United States do not have building codes.

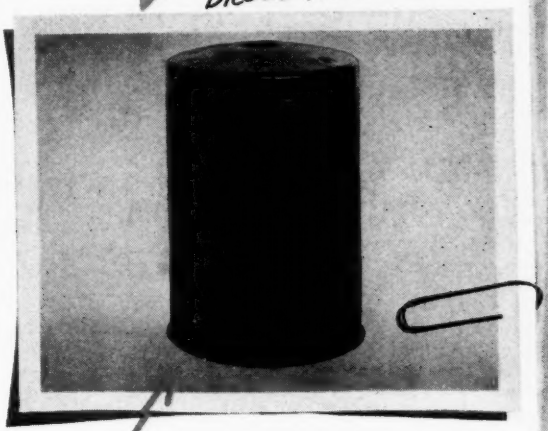
LUBE MEMO

How Joe stopped Filter Clogging



Joe says filters have gummed up like this after about 600 hours on oil he's been using

Joe says nothing but RPM Delo Oil in his Diesels from now on



Here's how the filter looked after 600 hours on RPM Delo Diesel Engine Lubricating Oil

Joe finds RPM Delo Oil keeps filters clean because:

1. It's compounded to resist oxidation and minimize sludge.
2. Its "detergent" cuts down sludge.
3. It remains stable in the presence of moisture.

DIESEL ENGINE RPM DELO LUBRICATING OIL

Set up trial on RPM Delo Oil Today!

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THE CALIFORNIA COMPANY • Denver, Colo.
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • New York

COAL LOOKS AHEAD

(*Continued from page 73*)

fashionable myth about coal: the claim that coal is in the industrial laggard in technological development. I will make only a brief defense here, for one statement should suffice. Coal in this country is much further advanced over coal mining in other major countries than is any other major industry in comparison with its foreign competition. In other words, our mining here has made greater advances over coal operations in England, Germany or Poland than, for example, have the steel industry or chemical industry surpassed the achievements of English or Germany steel or chemical plants.

We have had a constantly rising productivity which has more than doubled since 1900 and I believe this will continue even as we mine thinner and longer-haul coal. We produce over 5 tons per man-day in this country as compared to England's 1.1 tons. England produced 333 tons per man employed in the year 1883 and has never exceeded that record. Our own underground workers in our company produced over 1500 tons in 1946 despite over two months of strike shutdowns. Some of this nation's greatest mines, both surface and deep operations, from the standpoint of efficiency, are right here in Illinois. Your Orient Mine has enjoyed for years the reputation of being not only one of the largest underground producer but also one of the most efficient mines in this country.

To keep this steady progress constant changes in equipment are necessary. Over 50 percent of our coal in this country is now mechanically loaded rather than shoveled, whereas only 1 percent is so loaded in England, and England was completely dependent on coal for its economic life.

The Future of Coal

We think of steel as a cheap commodity and it is, for it sells for some 3 to 4 cents a pound. A pound of coal, on the other hand, frequently sells for less than 2 mills at the mines and that single pound of coal will move a ton of freight nine miles, or that same pound of coal will furnish the energy necessary to light an average home for 16 hours. Coal is cheap, it is abundant. And because this is so, our nation has prospered and has been able to prepare for the future with assurance.

If we compute the fuel energy reserves of the United States in terms of bituminous coal, we find the equivalent of slightly less than 5,000,000,000 tons of petroleum, and slightly more than 5,000,000,000 tons of natural gas, whereas coal reserves reach a figure of nearly 3,000,000,000,000 tons of bituminous coal. At the present time this country requires 1,260,000,000 tons, approximately half of which is furnished by coal. Petroleum furnishes one-third, natural gas one-eighth and hydro-electric power one-twenty-fifth. A decade from now our total energy needs have been forecast as 1,500,000,000 tons of coal equivalant. At this rate of growth, if petroleum alone were called upon to satisfy our total energy requirements, we would exhaust the reserves in less than four years; and natural gas, if it were called upon to assume the full burden, would only last a fraction of a year longer.

Putting this another way, if either petroleum or natural gas had been called upon to carry this country through the war unaided by other fuel sources, it would now be exhausted. So whether we like it or not, we must look to coal to satisfy our energy needs.

I acknowledge that in the short-term view there may be some encroachments on present coal markets by oil and natural gas. But the expansion of our needs for energy, particularly electrical power, and in the growing uses for chemicals where coal will carry the base load, will more than offset any encroachments.

The inevitable increase in the cost of finding and developing new fields of petroleum and gas, is another factor working in coal's favor. But we do not intend to coast on these natural trends. Where would the oil industry be today if kerosene were still its chief product? We in the coal industry must wrap up the energy that is in coal into a different package so that this energy can be used to the best possible advantage.

Coal Gasification

Research is the real reason for there being a Pittsburgh Consolidated Coal Company. We are deep in research for better, safer and cheaper mining. We are participating with a few other coal companies and railroads in paying for the development of the gas turbine locomotive which, I believe, will eventually beat the Diesel. We are also spending money with other companies to find better means of burning coal as a solid. But our particular path in research leads directly to coal gasification, and from there to the making of high-heat value gas and high octane gasoline.

This project in coal gasification, on which we soon will begin construction of a $300,000 pilot plant near Pittsburgh, Pa., is being conducted in collaboration with Standard Oil Development Company.

The pilot plant will enable us to prove that the job of rearranging atoms to form gas and gasoline can be done on a commercial basis as it has already been done in the laboratory. We are contributing with other oil companies to the building of a pilot plant using a somewhat different method by Hydrocarbon, Inc., in New Jersey.

The actual time when construction of a commercial size plant will be started in Western Pennsylvania depends on the economics involved but the trend toward higher development and recovery costs of natural gas and petroleum and the possibility of finding better methods by pilot plant operation lead us to believe that the time when we will start engineering such a plant will not be long delayed.

Allow me to illustrate this point still another way. In the light of present estimates, capacity of a plant costing $120,000,000 would be 400,000,000 cubic feet of gas per day during the months of severe weather and 14,000 barrels per day of high-octane gasoline with a lesser amount of gas fuel during the mild weather months. Some idea of the potential market for these primary products from coal gasification—gas and gasoline—can be had when it is considered that the greatest amount of gasoline that could be produced from the commercial plant we are considering would represent about ½ of 1% of the daily consumption of gasoline in this country.

Atomic Competition Possibilities

Some of you may wonder what place atomic energy may take in our expanding industrial world. No one knows the answer to that, but I don't think it will interfere in the foreseeable future with coal in this country. The only published report, one by Dr. Thomas of Monsanto Chemical, points out that an atomic energy power plant might be built for $333 per kilowatt and with 100% load factor, produce a kilowatt hour for 8 mills. A modern steam utility using coal can be built for $120 per kilowatt or about one-third the capital cost of the atomic power plant, and produce a kilowatt hour for 3 mills. No plant operates with 100% load for its lifetime and obviously the great difference in cost goes up much further as the load decreases. Atomic energy may come in; but places remote from coal regions would be the first sites.

In conclusion, I hope that I have shown you that coal is meeting most of its problems in an orderly way. As the country increases its standard of living, the use of coal will expand to furnish the required energy. And, as time goes along, coal will have to take over a part of the job now being done by oil and gas. The intense research now being carried on in coal will serve to make that day more sure and bring it closer.

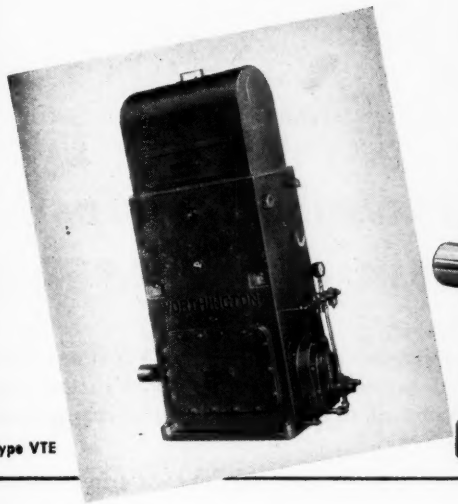
Coal is a hard and dynamic business. It is moving ahead with confidence. What can you do to help? Well, in the first place you can use your influence as citizens to see that coal is kept out of national politics and to see, as I stated in the beginning, that coal is not socialized with the dire results now happening in England. Also, you can learn to understand it better. If you do understand it better, it will be to think well of it, perhaps to speak well of it, and join with coal in a mutual effort to give our nation a stronger industrial future.

In 1899, says a Twentieth Century Fund survey, electricity provided 5 per cent of the power used in manufacturing. Thirty years later, it provided 80 per cent of the power.

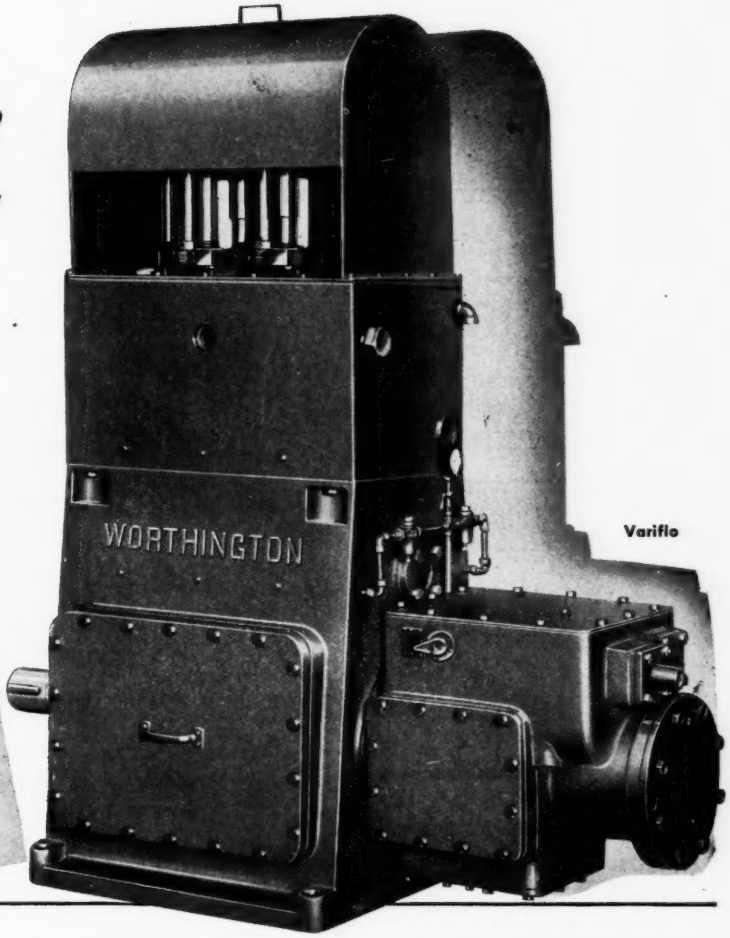
"PUTTING THE PRESSURE ON"

Smoothly . . . Exactly ...Automatically

Here's stepped-up efficiency for boiler feed and many other high pressure services!



Type VTE



Variflo

Positive, Accurate Capacity-Control

Operating at constant speed, Worthington Variflo Triplex Pumps regulate capacity by a simple, rugged eccentric which adjusts the plunger stroke to any degree from zero to 100%. Variation is completely *stepless and automatic*, with smooth, positive action that saves power over the entire capacity range.

Type VTE

Except for the crankshaft elements, the simple, compact, accessible design of Worthington Type VTE Triplex Pumps is identical with the Variflo's. Where variable capacity is not required, they perform with the same high dependability that proves *there's more worth in Worthington.*

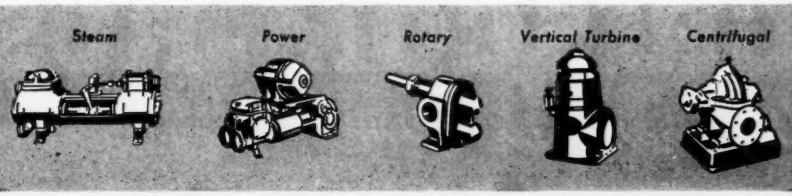
Constant Speed — Constant Savings

In Worthington Variflo and VTE Pumps the mechanical superiority and money-saving advantages of constant speed design have been developed to their fullest. Available in a complete range of sizes up to 165 gpm, in single units. Write for bulletins to *Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.*

WORTHINGTON

P7-1

THE WORLD'S LARGEST MANUFACTURER OF PUMPS



. . . if so, assure oil withdrawal in coldest weather with a G-FIN TANK OIL HEATER

Note These Advantages of the G-R G-FIN Tank Oil Heater

GREATEST HEATING EFFECTIVENESS . . . provided by the G-FIN elements which have six to eight times the heating surface of bare tubes

MOST COMPACT UNIT . . . fewer tubes and shorter shell for a given duty

LEAST PRESSURE DROP . . . has maximum free area and straight-through flow of oil

NO STRATIFICATION OR VAPOR BINDING . . . oil outlet at top of shell prevents dead pocket

USES LESS STEAM . . . heats oil only locally at point of withdrawal

FEWER TUBE JOINTS . . . resulting from small number of required heating elements

ACCESSIBILITY . . . easily examined and cleaned throughout entire length and diameter of heating elements

LEAKPROOF JOINTS . . . the conical ends of the heating elements are seated in the tube sheet with accurately machined metal-to-metal joints held tight by lock-nuts

NO TEMPERATURE STRAINS . . . the U-bend elements are free to expand or contract

Many hundreds of installations of the G-R G-FIN Storage Tank Oil Heater have fully demonstrated the speedy action, thorough reliability, low steam consumption, and economical maintenance of these units.

Users report that even in sub-zero temperature, or where oil has partly solidified through long periods of storage, these highly effective heaters assure a steady flow of oil soon after steam has been turned on.

Wherever fuel oil, lubricating oil, crude oil, road oil, tar, asphalt, glycerine, cotton seed oil, molasses or other viscous liquids are stored . . . at process plants or power plants, tank farms or distributing centers, loading wharves or platforms . . . the G-R G-FIN Tank Oil Heater is a necessary insurance against difficulties or delays in oil withdrawal. Available for installation outside of, or partly within the tank.

Write for Bulletin 1641 describing these units in detail.

THE GRISCOM-RUSSELL CO.

285 Madison Avenue **New York 17, N. Y.**

GR-133

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

QUICK AS A FLASH!

LIMITAMP CONTROL

GIVES SURE, SHORT-CIRCUIT PROTECTION

In less than *one-quarter* cycle, EJ-2 fuses in Limitamp control can cut off a rise in current from a short, and clear it in one-half cycle—long before the short has time to harm the contactor or motor. Your plant's power system needs this prompt handling of fault currents, and you will avoid the risk of costly shutdowns that can result from one, mad short circuit.

A STARTER AND PROTECTOR IN ONE CABINET

G-E Limitamp control consists of an airbreak contactor (the motor starter), and EJ-2 fuses (the short-circuit device). They are mounted in separate compartments of one, all-steel cabinet.

Airbreak contactors are specially designed for hard duty. Operating experience has proved they furnish reliable, low-cost service with only routine maintenance.

Because they operate in air, they eliminate the problem of handling oil. And tip life of airbreak contactors is many times that of comparable oil-immersed tips.

You can depend on EJ-2 fuses for sure, short-circuit protection. They are "fail-safe" devices. There is nothing about them to wear. They are easy to replace.

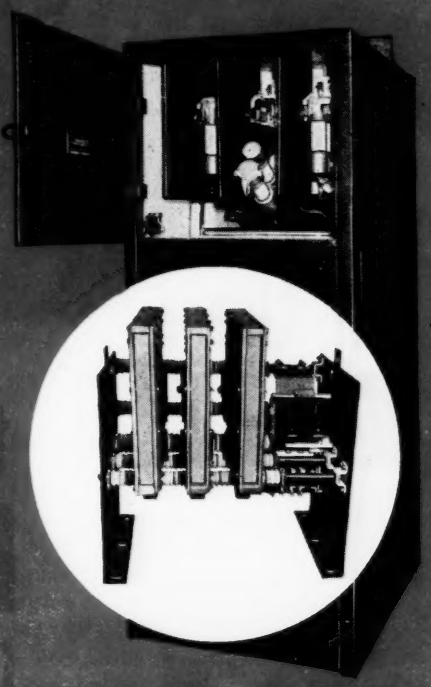
OVERLOAD AND UNDERVOLTAGE PROTECTION

Isothermic overload relays, accurately calibrated against actual motor characteristics, guard the motor against overheating from sustained loads or single phasing.

FACTORY-ASSEMBLED CONTROL

Factory-assembled in one cabinet, Limitamp is easy to install, easy to co-ordinate with other control, saves space, and improves the appearance of your plant.

GENERAL ELECTRIC



Limitamp control is furnished as a single unit, in groups, or in special enclosures for special operating conditions.

The Trend is to AIR

G-E LIMITAMP . . . THE FIRST HIGH-VOLTAGE CONTROLLER WITH AIRBREAK CONTACTORS

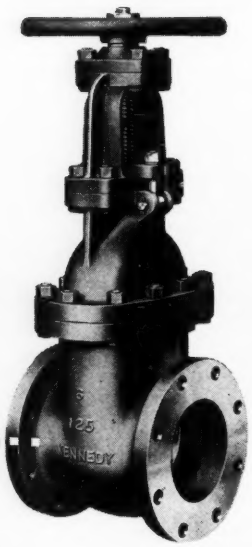
Apparatus Department,
General Electric Company, Section L676-250
Schenectady 5, New York

Please send me Bulletin GEA-4247 on Limitamp control.

Name.....

Company.....

Address.....



specify this..... on the **outside**

to get **durability** on the **inside**

Kennedy Valves are durable. Look at this iron-body gate valve . . . note the stout construction of the disc . . . the exceptionally thick and wide disc and seat rings . . . the heavily proportioned stem threads.

You get these and many other features when you specify Kennedy Valves. Want full details? . . . write for a copy of Kennedy's 240-page Catalog. It contains complete information on the Kennedy bronze and iron-body gate, globe, angle and check valves, pipe fittings, flanges, and other valves and accessories.

BUY FROM YOUR LOCAL DISTRIBUTOR

KV-148

The Kennedy Iron-body Wedge Gate Valve is made for a range of pressures with non-rising stem or outside-screw-and-yoke. Illustration shows standard type, outside-screw-and-yoke.

KENNEDY valves-pipe fittings-fire hydrants

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK *Offices and Warehouses in Principal Cities*

FOR THE FIRST TIME!

A UTILITY Jackhamer

Having **UTILITY WEIGHT**
REAL DRILLING POWER
AUTOMATIC ROTATION
Air Operated

This amazingly *powerful* Jackhamer weighs only 14 lbs and can be used wherever *light weight* is of first importance. It handles easily on a scaffold or ladder and makes short work of holes for hangers, anchor bolts, foundation bolts, pipe, conduit, dowels, and reinforcing rod. It is deal for plug and feather work.

The "J-10" tears out brick work for doorways and windows or cuts anchors for girders and joists. It is used for chiseling and channeling and for vibrating concrete forms.

At last, here is a real Rock Drill—*air operated*—built for plant maintenance work. It is no longer necessary to use make-shifts. The "J-10" UTILITY Jackhamer is fast, powerful, easy to handle, has strong rotation and hole blowing and uses standard Jackbits. Buy a J-10 UTILITY Jackhamer to save TIME AND MONEY.

The "J-10" UTILITY Jackhamer
is built by the world's largest
manufacturer of Rock Drills and Compressors

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THE HIGH COST OF BACK-PRESSURE: $21000/year

Just exactly how high the cost of back-pressure really is was recently proved in a Southern power station. Slime-fouling on condenser water side surfaces accumulated between plug cleanings to build back-pressure up from approximately 0.6″ to a maximum of 1.1″. That extra back-pressure on a 30000 KW base load unit *boosted* steam consumption an average of 7500 pounds per hour. At a cost of about $0.34 per thousand pounds and with the turbine operating 24 hours per day 350 days per year, the cost of back-pressure figures out to be $21000 per year.

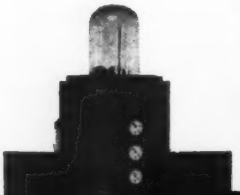
THE LOW COST OF CORRECTION: $5000/year

Chlorination applied through the W & T De-Sliming Process, at a total annual cost of approximately $5000 including amortization and all operating expenses kept the condensers slime-free, eliminated the need for plug cleaning and reduced equipment outage time.

NET $AVINGS: $16000/year

Not only did chlorination make operations easier and more effective, but the annual savings in steam alone amounted to $16000 — enough to pay for the investment in less than two years.

Your W&T Representative will be glad to make a study for you—without obligation, of course—to see if you, too, are paying the high cost of back-pressure.



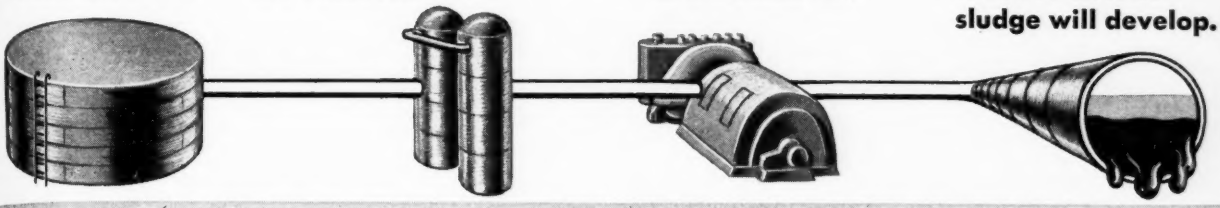
CD-26

WALLACE & TIERNAN PRODUCTS, INC.

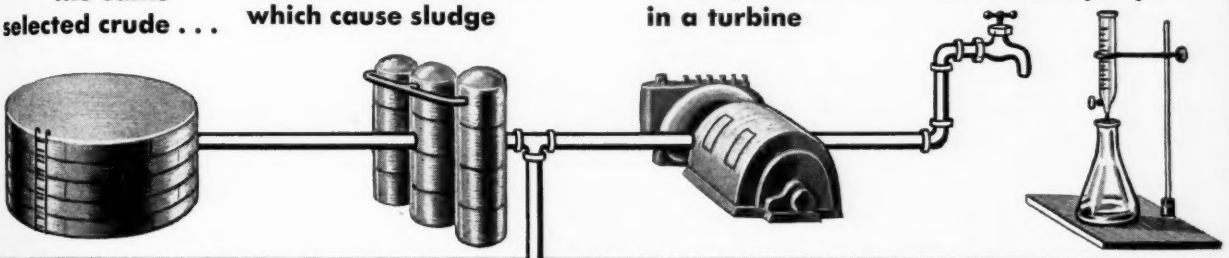
Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, New Jersey • Represented in Principal Cities

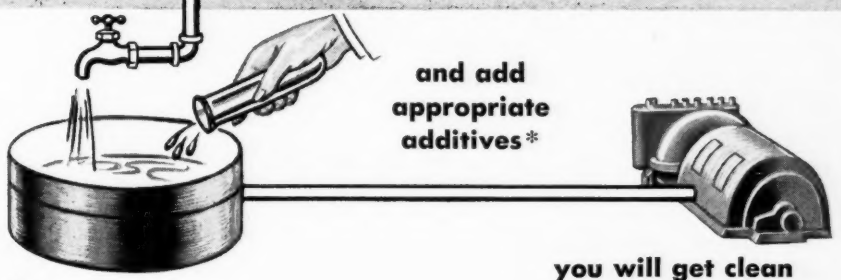
If a selected crude stock . . . is refined so that only part of the asphaltene-formers are removed . . . and the resultant oil is operated in a turbine . . . acidity formation may not be excessive but a lot of sludge will develop.



If the same selected crude . . . is highly refined to remove all asphaltene-formers which cause sludge and the resultant oil is operated in a turbine acidity will increase rapidly.



But if you take that highly refined oil and add appropriate additives* you will get clean operation and low acidity formation for the life of the turbine.



That's why

NONPAREIL TURBINE OIL

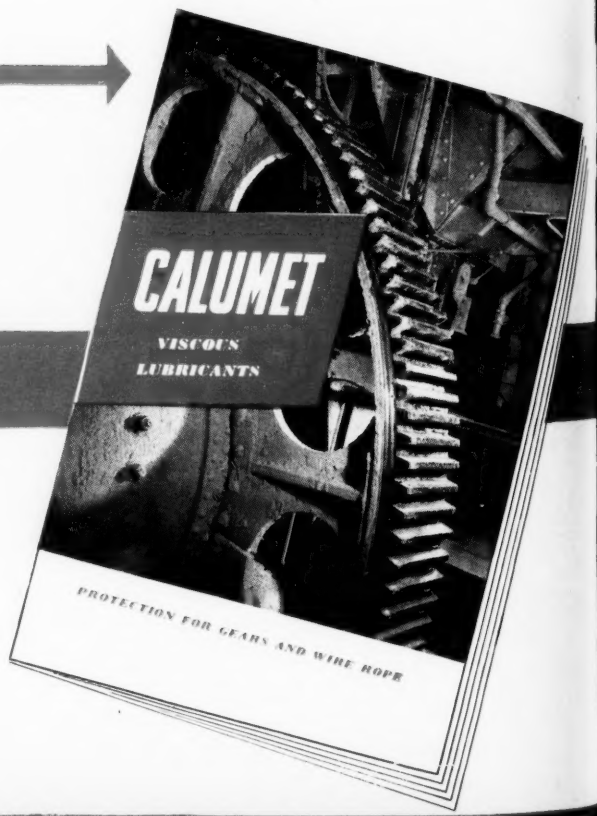
Never has to be changed, treated or removed from a turbine

*The process of producing Nonpareil Turbine Oil includes the use of effective additives which retard oil oxidation and the rapid formation of acidity. This process makes it possible for Standard Oil to guarantee Nonpareil against an acidity increase above 0.15mg.KOH/gm. as long as it is in your turbine. Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Why Calumet Viscous Lubricants reduce wear on gears ....why they add life to wire rope ....why they adhere to metal and resist removal by heat or water ...these are some of the subjects fully discussed in this booklet →

It may lead you to worthwhile savings.



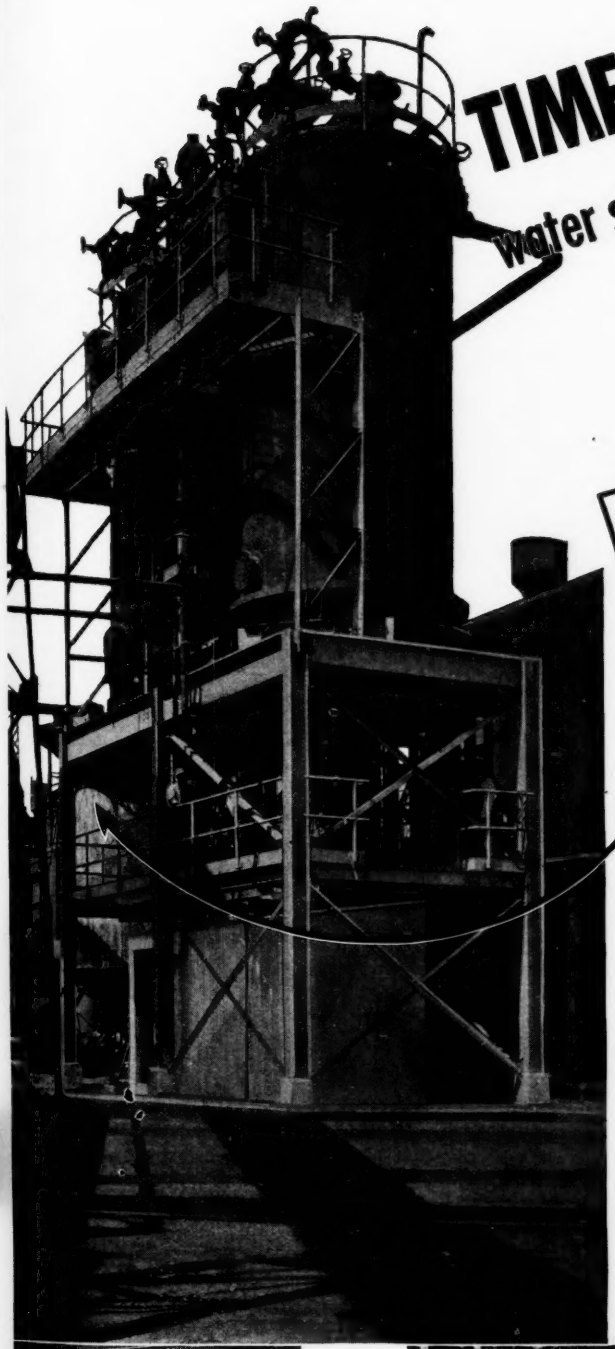
SEND FOR A COPY

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, or ask the Standard Oil Representative who calls on you for a copy.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

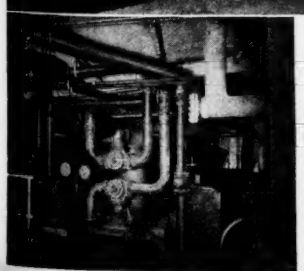
TIME (and improvement in water softening) MARCHES ON!



Original (1925) Softener

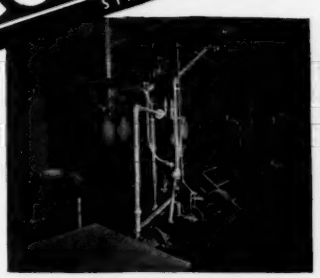
IN 1925, a Cochrane Hot Process Softener was installed in the Tilghman Street Gas Plant of the Philadelphia Electric Company at Chester, Pa. Now, 22 years later, this faithful old piece of equipment is being replaced by a new Cochrane Double Unit Hot Process Softener of 20,000 GPH capacity (10,000 GPH per unit). The double unit permits great flexibility of operation as one or both units may be used as desired. The needs of the plant have outgrown the capacity of the first unit which is largely the reason for the change, but the improvements in the process and the apparatus since 1925 are interesting in comparison with the old veteran. Welded construction replaces riveted, chemical proportioning and feeding are improved, automatic controls are featured and softening is accomplished with a speed and accuracy of result undreamed of in 1925.

COCHRANE
SINCE 1863



(Left) Two vertical pressure filters replacing existing conical filters shown in background

(Left) phosphate tank with motor driven agitator for mixing supplemental phosphate feed



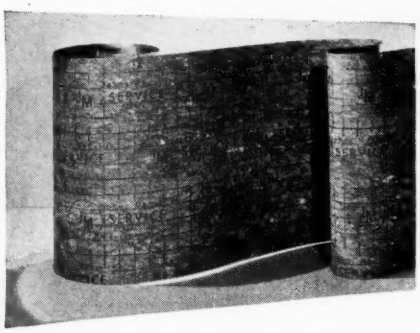
(Left) Lime soda proportioners and mixing tanks

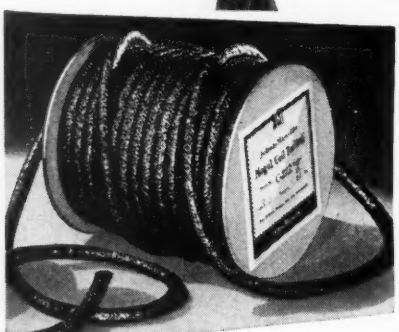
COCHRANE CORPORATION · 3123 N. 17th Street · PHILADELPHIA 32, PA.

3 good packings to know

Here are 3 Johns-Manville Packings that have earned a reputation for their long-wearing, money-saving qualities:

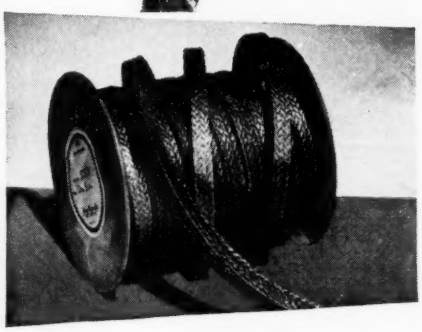
J-M Service Sheet has long been industry's first choice sheet packing. Engineers know it lasts long under a wide variety of service conditions . . . seals tightly against superheated steam, gas, water, oil and many other liquids.





J-M Mogul Rod and Valve Stem Packing is graphited inside and outside to relieve internal friction . . . stays soft and pliable throughout its long service life. Use Mogul against air, water, ammonia, oil and many other fluids . . . wherever a soft, pliable packing without rubber is needed.

J-M Interlocked Braided Rod Packing has no jackets or plaits to unravel or come apart. It is braided square to form a dense integral structure that provides a tight, long-lasting seal with minimum gland pressure and take-up. For either reciprocating or rotating service.



There's a Johns-Manville Packing for every service condition. You'll find the right one, together with recommendations for its application in the J-M Packing Catalog. Ask your J-M Distributor for a copy or write Johns-Manville, Box 290, New York 16, N. Y.

JM PRODUCTS

Johns-Manville
PACKINGS & GASKETS

COMING EVENTS

NAPE—National Association of Power Engineers, Annual Show and Convention; to be held August 25 through 28 with headquarters at Hotel Statler.

ASME—Fall Meeting of American Society of Mechanical Engineers; to be held in Salt Lake City, September 1 through 4, with headquarters at the Hotel Utah.

Instrument Society—Instrument Society of America annual meeting; to be held the week of September 8, 1947, with headquarters at the Stevens Hotel, Chicago.

Instrumentation Conference—Instrumentation Conference and Exhibit for 1947; to be held the week of September 8, with headquarters at the Stevens Hotel, Chicago.

AISE—The annual meeting of the Association of Iron and Steel Engineers will be held at Hotel William Penn, Pittsburgh, Pennsylvania on September 22, 23, 24 and 25, 1947.

ASME—Fuels Division Meeting of the American Society of Mechanical Engineers; to be held, October 6 through 8, in Houston, Texas. (Headquarters not yet announced.)

Hydraulics—Third Annual Meeting of the National Conference on Industrial Hydraulics (formerly the Hydraulic Machinery Conference); to be held October 16 and 17 in Chicago with headquarters at the Hotel Continental.

ASM—The 29th Annual National Metal Congress and Exposition; to be held in Chicago's International Amphitheatre for seven days beginning Saturday, October 18th, 1947.

Water Conference—The 8th Annual Water Conference of the Engineers' Society of Western Pennsylvania will be held in the William Penn Hotel, Pittsburgh, Pa. on November 12, 13, and 14.

Notice — Midwest Engineering and Power Exposition originally scheduled for November 15 through 20 has been canceled.

ASME—Annual Meeting of the American Society of Mechanical Engineers; to be held in either New York City or Atlantic City, N.J., December 2 through 5. Headquarters Chalfonte-Haddon Hall.

Refrigeration and Air Conditioning Exposition—Fifth All-Industry Exposition; to be held January 26 through 29, 1948 with headquarters at Cleveland Public Auditorium, Cleveland, Ohio.

Obituaries

G. L. KOTHNY

G. L. KOTHNY, vice-president and general sales manager of the Sperry-Sun Well Surveying Co. and prominent inventor of industrial equipment, died recently at Bryn Mawr Hospital where he had been a patient three weeks. He was 66. His home is on West Valley Road, Strafford, Pa.

Mr. Kothny had been with the Sperry-Sun Well Surveying Co., a wholly-owned subsidiary of Sun Oil Co., since 1929. He was born in Troppau, Czecho-Slovakia, and educated at the Universities of Reichenberg and Prague.

Mr. Kothny contributed numerous articles to scientific journals and in 1920 received the Franklin Institute Medal of Merit as co-inventor of the Radojet Air Pump which became standard equipment for ships.

During his long career as a designing engineer he served as consultant to industrial firms in several European countries.

Mr. Kothny was a member of the

ASME, the AIMME, the Society of Naval Architects and Marine Engineers, American Petroleum Institute, and the Franklin Institute.

Surviving are his wife, the former Rose Kallies, and two brothers and two sisters who live in Europe.

ALFRED STANLEY MARLOW

ALFRED STANLEY MARLOW, of 768 Upper Boulevard, Ridgewood, widely-known pump manufacturer, died recently of a cerebral hemorrhage at the Hackensack Hospital, Hackensack, N. J., to which he had been removed only a few hours before. He had been in poor health for a long time.

Mr. Marlow was born in Coventry, England, on September 19, 1885, the son of Caleb Marlow and Florence Bell. He came to this country with his parents in 1903, having completed his schooling in England, and was employed for a time by Fairbanks-Morse in Chicago. In 1924, he started in business for himself, opening the Marlow Pumps, Inc. works at Bartley, New Jersey, and in 1929 built the present plant at Midland Park, New Jersey. He was president of the company operating the plant.

NEWS *from* THE FIELD

AMERICAN GAS & ELECTRIC ELECTS SPORN PRESIDENT

PHILIP SPORN, executive vice-president of the American Gas & Electric Co. and executive vice-president and chief engineer of all of its subsidiaries, has been elected president of the holding company to succeed George N. Tidd, who becomes chairman of the board. C. E. Groesbeck, former chairman, whose term of office had expired, declined reelection, it was announced.

Mr. Sporn is credited with a large share in the evolution of one of the most outstandingly coordinated interconnected power systems in the United States. Joining the staff of American Gas & Electric Co. in 1920, in the ensuing years he held successively, and frequently simultaneously, the positions of protection engineer, communication engineer, transmission and distribution engineer, station engineer, and assistant electrical engineer. In 1927, he was made chief electrical engineer of American Gas & Electric Co. and of all its operating companies, and in 1934 he was elected vice-president of American Gas & Electric Co. in charge of all engineering activities.

Then, with the formation of the American Gas & Electric Service Corp. in 1938, he was elected to the office of vice-president and chief engineer of that corporation in charge of all its engineering activities and those of the operating companies of the A. G. & E. system.

In 1945 he was made executive vice-president of American Gas & Electric Co., of American Gas & Electric Service Corp., and of all electric utility subsidiaries of the American Gas & Electric Co., retaining the responsibility of chief engineer of all these operations. Functioning in that capacity and in associated capacities in the course of the past 27 years, he has done much original work in the field of power supply, distribution and protection.

AIR CONDITIONING EXPOSITION TO BE RECORD BREAKER

CURRENT indications confirm early forecasts that the forthcoming Air Conditioning Exposition in New York will be one of the greatest events of its kind held. Rivaling in

A good man to know

He's your Johns-Manville Packing Distributor—and he is one of 400 conveniently located industrial distributors who stock Johns-Manville Packings in many forms and styles.

Call on him when you need packing. You'll find his service prompt . . . and his knowledge of packing problems a big help in selecting the right packing for your job.

The sign of a good man to know

The Johns-Manville Packing Distributor in your community displays this sign. You'll find his place of business a convenient supply depot—not only for Packing, but for many other industrial supplies as well. Whenever you need an essential part, or tool, or material, you can count on your Johns-Manville Packing Distributor for prompt, efficient service at all times.

JM PRODUCT

Your Johns-Manville
PACKING DISTRIBUTOR

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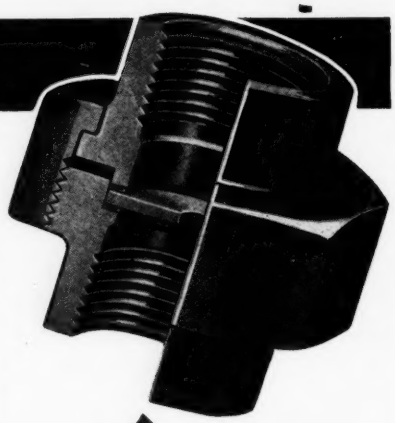
FORGED STEEL UNIONS

Orifice

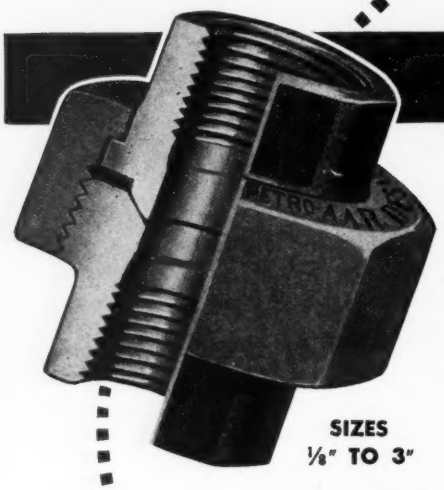


A SIMPLE, EASY-TO-HANDLE, MODERATELY PRICED, ORIFICE UNION.

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas and Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.

SIZES ¼" TO 3"

Petro



AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

SIZES ⅛" TO 3"

A PARTIAL LIST OF PROVEN SERVICES

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS SINCE 1912

WRITE FOR PAMPHLET AM-67 • ORDER BY TRADE NAME FROM YOUR JOBBER

CLAYTON MARK & COMPANY
1900 DEMPSTER STREET • EVANSTON, ILLINOIS

number of exhibitors, at this time the record-breaking display of last Winter in Cleveland, the 8th International Heating and Ventilating Exposition, as it is officially known, will be the first in a decade to be held within the boundaries of the huge New York marketing area. The Exposition will occupy every foot of display space in Grand Central Palace, it is now assured. It will be held during the week of February 2-6, 1948.

Exhibitors' response to the preliminary announcement of the exposition was remarkable. Within three weeks 370 spaces had been engaged. The follow-up of applications indicates that all space will be exhausted long in advance of opening day.

RELAY MANUFACTURERS FORM NATIONAL ASSOCIATION

AN AGGRESSIVE membership campaign, now in progress, is the belated announcement of a lusty infant in the industrial world.

The infant is christened NARM—a pronounceable combination of initials for the National Association of Relay Manufacturers. And the initial goal of the organization is the establishment of a code of standards by which electrical relays may be tested and rated.

The association was formally organized in Chicago on May 17 when representatives of leading relay manufacturers from all parts of the country drew up a charter of aims and elected Ralph T. Brengle, of Potter & Brumfield Sales Co., Chicago, as the first president.

Also named to the executive panel at the time were: C. P. Clare, of C. P. Clare and Co., Chicago, vice-president; and J. J. Rowell, of Guardian Electric Manufacturing Co., Chicago, secretary-treasurer.

A number of efforts toward standardization of relay ratings have been made in the past by individual companies, but have not been broadly accepted—and ASTM has never established standards. The consequence, of course, has been confusion through the use of empirical ratings based on a variety of factors—with few of the manufacturers giving common consideration to all of the same factors. The result creates a situation in which some ratings are conservative and some are liberal—and buyers may receive widely differing relays from two manufacturers, even though published specifications are identical.

AIEE ELECTS OFFICERS

BLAKE D. HULL, Chief Engineer, Southwestern Bell Telephone Co., St. Louis, Mo., was elected president of the AIEE for the year beginning August 1, 1947, as announced at the annual meeting of the Institute held in Montreal, June 11. The other officers elected were: Vice-Presidents G. W. Bower, Haddonfield, N.J., J. H. Berry, Norfolk, Va., I. M. Ellestad, Omaha, Nebr., D. I. Cone, San Francisco, Calif., D. G. Geiger, Toronto, Ontario; Directors W. L. Everitt, Urbana, Ill., A. C. Montieth, East Pittsburgh, Pa., Elgin B. Robertson, Dallas, Tex.; Treasurer W. I. Slichter, New York, N.Y. (Reelection).

STEVENS INSTITUTE AWARDS HONORARY DEGREES

SEVEN honorary degrees were conferred at commencement exercises at Stevens Institute of Technology recently in the William Hall Walker Gymnasium. Dr. Donald Babcock Keyes, director and vice president in charge of research and development of the Heyden Chemical Corp., New York, gave the commencement address and received an honorary degree of doctor of engineering.

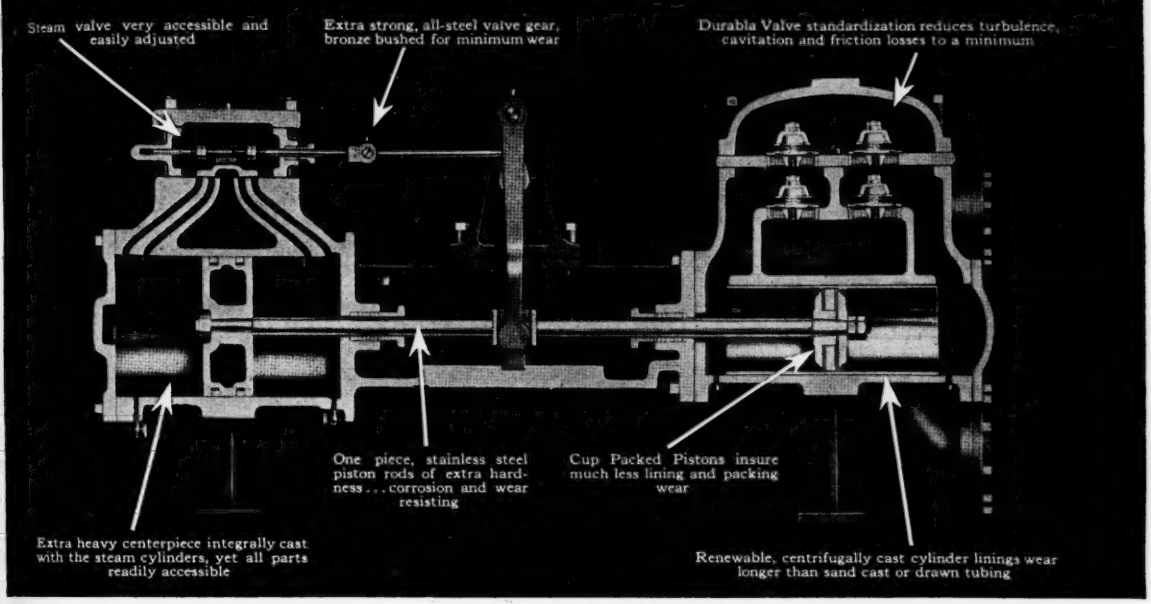
Honorary degrees of doctor of engineering also were conferred on four men who are celebrating respectively the 60th, 50th, 40th and 30th anniversaries of their graduation from college. They are John Lyman Cox, chief engineer of the Midvale Co., Philadelphia; Harry Thurber Woolson, vice president of the marine division of the Chrysler Corp. and president of Chrysler Institute of Engineering, Detroit; Frederick Ackerman Lydecker, vice president in charge of gas operation of the Public Service & Gas Co., Newark; and Philip Sporn, executive vice president of the American Gas & Electric Service Corp., New York.

The honorary degree of mechanical engineer was awarded to Ennis Winthrop Bach-

A TYPICAL EXAMPLE OF

Superior Pump Engineering

WARREN REALWEAR STEAM PUMP


Steam valve very accessible and easily adjusted
Extra strong, all-steel valve gear, bronze bushed for minimum wear
Durabla Valve standardization reduces turbulence, cavitation and friction losses to a minimum
One piece, stainless steel piston rods of extra hardness . . . corrosion and wear resisting
Cup Packed Pistons insure much less lining and packing wear
Extra heavy centerpiece integrally cast with the steam cylinders, yet all parts readily accessible
Renewable, centrifugally cast cylinder linings wear longer than sand cast or drawn tubing

THE Warren "Realwear" is an example of engineering from *your* viewpoint. Notice the plus features in the cutaway view above. Compare with any similar make.

This is the type of engineering that goes into *every* Warren pump—both reciprocating and centrifugal. Dependability, maintained efficiency with low maintenance costs are first considerations. Let us talk with you about your next pumping problem. Write:

WARREN STEAM PUMP COMPANY, INC.
Warren, Massachusetts

Atlanta Boston Chicago Cleveland Denver Detroit Houston
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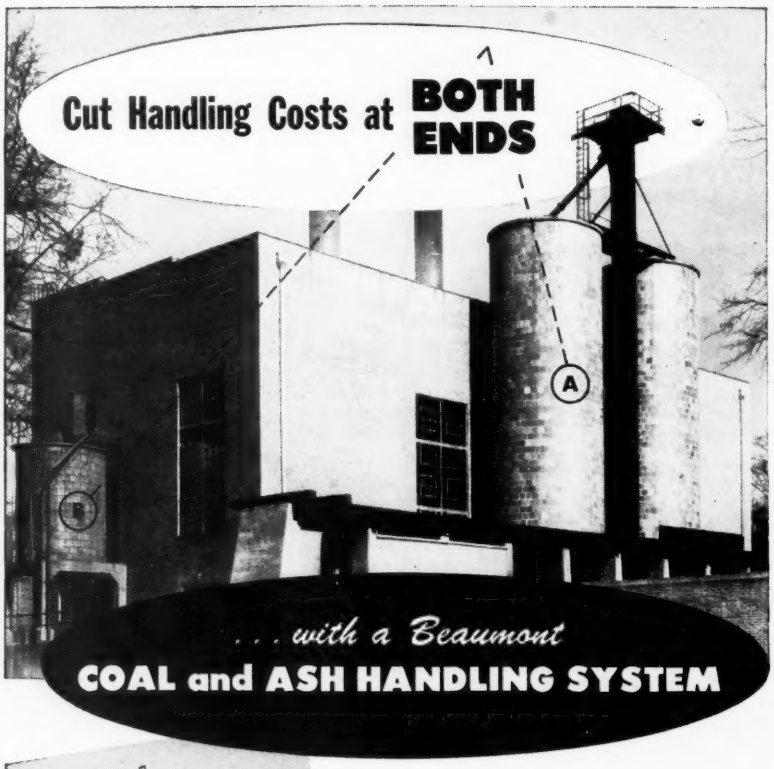
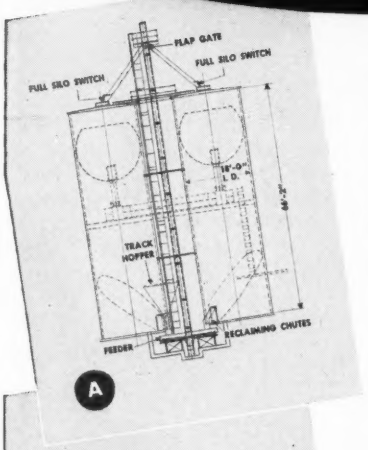
Warren Pumps

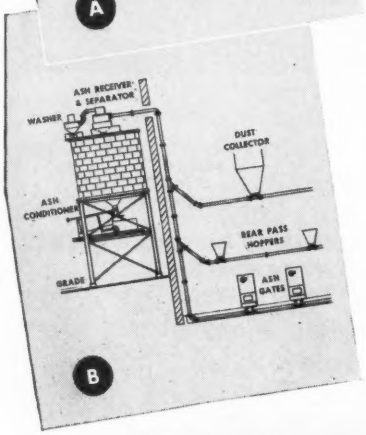
CENTRIFUGAL AND RECIPROCATING

P-10

1897 — OUR FIFTIETH ANNIVERSARY — 1947







COAL HANDLING

With Beaumont Birch Coal Handling Equipment, one operator controls all coal from the time it arrives by rail and is dumped in the track hopper, through its lifting by bucket elevator, to its use —immediate or future.

ASH REMOVAL

The Beaumont "Vac-Veyor" system offers the most direct and economical method for removal of ashes, siftings, soot and dust. They are vacuum conveyed through a pipe from their source to an ash receiver and separator—then into the silo where they remain until final disposal.

Beaumont engineers design and erect this equipment—a complete coal and ash handling system. This brings you savings in installation as well as in handling costs—you have one contract, we have sole responsibility.

Write for more information to:

BEAUMONT BIRCH *Company*

1503 RACE STREET—PHILADELPHIA 2, PENNA.

Designers *Manufacturers* *Erectors* BULK MATERIAL HANDLING SYSTEM

man, manager of the welded alloy tube division of the Carpenter Steel Co., Elizabeth, N.J. and Stephen Alexander Crosby, president and director of Sterling Products Co., Chicago.

INSTRUMENTATION COURSE AT TEXAS A & M

THE AGRICULTURAL and Mechanical College of Texas will conduct its second annual short course in "Instrumentation for the Process Industries" at College Station, August 27-28-29.

Last year's course, in spite of a delayed start in organization, was attended by more than 200 engineering, technical, and operating men from the various industries in the Gulf Coast and Mid-Continent territory.

The course is outlined on an Engineering level. The speakers scheduled for this year's Session, will be drawn largely from operating companies.

For those interested, who might have been omitted on the mailing lists, further information can be obtained by writing: Dr. P. G. Murdoch, Engineering Department, A & M College, College Station, Texas.

Prof. A. G. Christie of The Johns Hopkins University, has gone to England to the Centennial of the Institution of Mechanical Engineers as one of the representatives of the ASME, of which he is an Honorary Member and Past President. He will also attend the meetings of the Institute of Fuels. Later he goes to Switzerland on negotiations for large gas turbines.

At the Annual Meeting of the American Refractories Institute held recently, Donald N. Watkins was elected a Director to succeed Wm. P. Hemphill. Mr. Watkins is President and General Manager of the Laclede-Christy Products Co. of St. Louis, Missouri.

Dennistoun W. Ver Planck, professor of electrical engineering at Carnegie Institute of Technology has been named head of the department of mechanical engineering and professor in that department, effective September 1, it was announced recently. Dr. Ver Planck will assume the position last held by Willibald C. L. Trinks, former mechanical engineering head, who retired in 1943. Professor Thomas G. Estep has served as acting department head in the meantime.

Dr. Harold V. Hawkins has been named professor of civil engineering at Illinois Institute of Technology, President Henry T. Heald has announced. The appointment is effective September 1. Dr. Hawkins is chief electronics engineer of Bell Aircraft Corp., Buffalo, N.Y., with which he has been associated since 1941.

MANUFACTURERS' *News*

STERLING INC., UNDER NEW MANAGEMENT

IT HAS been recently announced that Sterling, Inc., manufacturers of heating specialties, controls and pumps is now under new management. The stock of this old established company has been purchased by a group of well-known Milwaukee business men. Two of the new owners will be active in the management of the company.

Paul A. West, with a background of over twenty years experience in sales work for some of Milwaukee's leading metal products manufacturers, will direct the sales along with his duties as president of the new company.

John B. Ballard, vice president in charge of manufacturing, comes to Sterling having been associated with a large Milwaukee manufacturer of electrical and automotive products. Mr. Ballard's education and experience in engineering, factory management, and production control will be very valuable in the conduct of manufacturing operations.

To facilitate filling of current orders as

Presenting

a pictorial record of standard and special built HEAT TRANSFER EQUIPMENT

by **Vogt**

Write for a copy of Bulletin HE-5, on your letterhead.

You are invited to send for this record of ingenuity in heat exchanger design and construction.

Shown, among examples of the many types we build, are units for diversified applications, high pressures, and special operating conditions as well as conventional types for ordinary exchanger services in petroleum refineries, chemical plants, process industries, power plants, etc.

Thousands of installations in successful operation attest to Vogt's ability to give effective help in the solution of heat transfer problems peculiar to a wide variety of operating conditions.

HENRY VOGT MACHINE CO.
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LOUISVILLE 10, KENTUCKY
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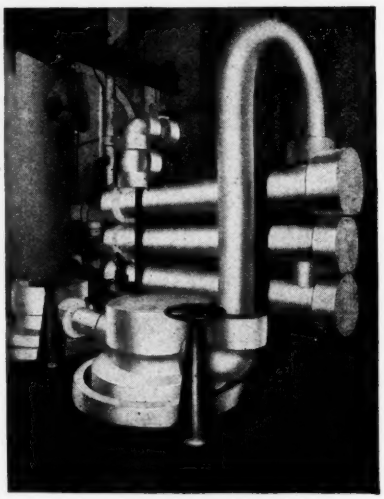
CLEAN STEAM
means SAVINGS



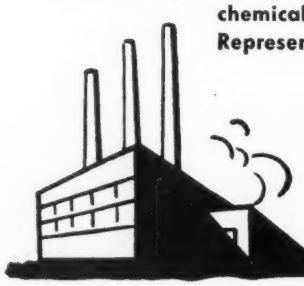
HENSZEY

CONTINUOUS BLOWDOWN

effectively controls boiler water concentration to prevent carryover into steam lines.

Remember . . . CLEAN STEAM contributes to longer boiler life . . . makes packings last longer . . . reduces wear on rods and cylinders . . . reduces turbine blade erosion . . . keeps tube burns at a minimum . . . prevents superheater burnouts . . . prevents sticking of reducing valves, traps, etc.

So for continuous, automatic boiler water concentration control in EXISTING or PLANNED power plants, consider Henszey Continuous Blowdown . . . the time proved system that prevents priming, foaming, and the formation of sludge and scale (with proper chemical treatment). Call your nearest Henszey Representative or write to



HENSZEY COMPANY
DEPT. C8 • WATERTOWN, WISCONSIN

HENSZEY

CONTINUOUS BLOWDOWN
and BOILER PLANT SPECIALTIES

Boiler Feed Regulators • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PREHEATERS

promptly as possible, the entire shop has been put on an overtime schedule and additions are being made to personnel to build up production schedules to new and higher levels despite material shortages still plaguing the industry.

COOPER-BESSEMER ANNOUNCES WORLD'S LARGEST COMPRESSOR

PRODUCTION of the largest gas engine-driven angle compressor in the world, expected to effect substantial savings in installation and piping costs in the natural gas transmission and processing industries, is now under way in the Mount Vernon, Ohio, plant of The Cooper-Bessemer Corp.

Five of the new giant units, known as the "Type GMW," have been ordered by the Panhandle Eastern Pipeline Co. to meet unprecedented demands for natural gas in the Eastern and Mid-Western industrial areas.

The new compressor was designed for the gas transmission and natural gas processing industries, and is expected to find widespread demand because of the potential saving it offers in the reduction of installation, piping, foundation, and other building and servicing costs. The user's estimates indicate savings in installation costs ranging from six to twelve dollars per horsepower.

The new "Type GMW" is a two-cycle V-type engine and is available in six, eight, and ten-cylinder sizes. With an 18-in. bore and 20-in. stroke it is rated 240 hp per cylinder at a speed of 250 rpm.

AIR REDUCTION TO OPEN TWO NEW OXYGEN PLANTS

Two oxygen manufacturing plants were added to Air Reduction's nationwide chain with the opening of a new plant at Baton Rouge, La., and another at Decatur, Ill., according to a recent announcement.

The Louisiana plant was built to supply the increasing oxygen demands of Louisiana industry, particularly in the south and central parts of the state.

The plant superintendent will be J. L. West who has been with Air Reduction for over twenty-five years.

In addition to supplying the oxygen requirements of the nearby Wabash Railroad maintenance shops, the new Illinois plant will be able to supply oxygen to points formerly serviced by Air Reduction plants in St. Louis and Chicago. The superintendent of the new Decatur plant is George H. Klingenberg who has been with Air Reduction for over twenty years.

NELSON ELECTRIC'S EXECUTIVES NAMED

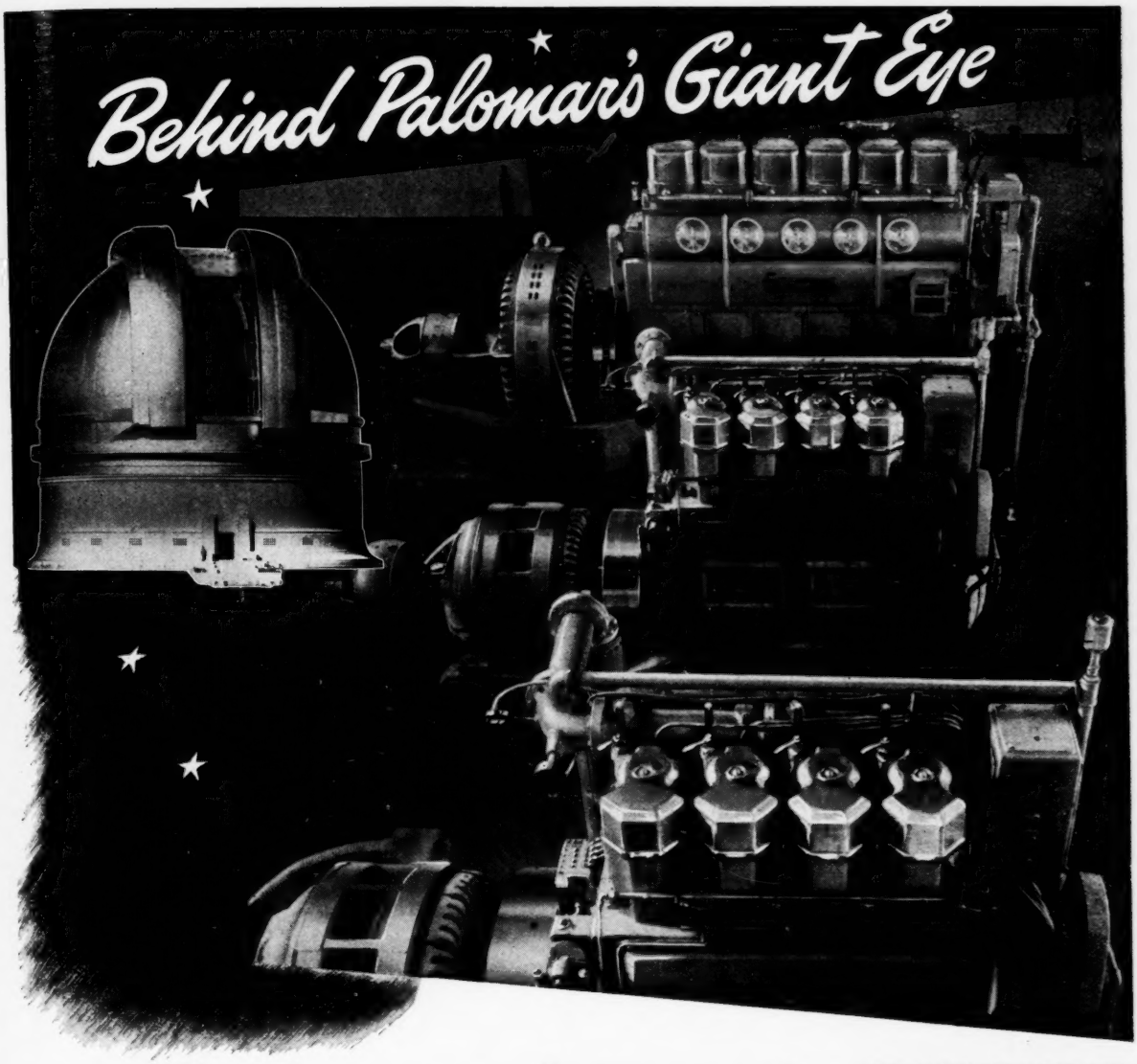
NELSON Electric Corp., 1620 Euclid Street, Santa Monica, one of the coast's leading manufacturers of transformers and other electrical products has announced appointment of executive personnel and board members of the recently organized corporation: George Otis, Vice-President and Director; Daniel W. Gage, Secretary, Director and Corporation Counsel; Jack D. Phelan, Sales Manager and Director; Eugene Leitner, Treasurer; Henry Butz, Chief Engineer.

A-C FORMS TURBO POWER DEPARTMENT

FORMATION of a new turbo-power development department in the engineering development division of the Allis-Chalmers Manufacturing Co. has just been announced.

R. C. Allen, one of the country's leading turbine engineers and former head of the Allis-Chalmers steam turbine dept., has been named manager and chief engineer of the new department. W. A. Yost, formerly assistant manager, succeeds Mr. Allen as manager of the steam turbine department.

Recognition of the growing importance of many current engineering projects in the gas turbine and other turbo-power fields, which have departed from current steam turbine practices, is the basis for creating the new turbo-power development department. In view of the great amount of research and design involved in gas turbine development, the move can be expected to accelerate progress in these



Stellar power performance by ENTERPRISE

ENTERPRISE *Diesels*

ENTERPRISE ENGINE & FOUNDRY CO.,
18TH AND FLORIDA STREETS
SAN FRANCISCO 10, CALIFORNIA

CHICAGO • LOS ANGELES • TULSA

NEW YORK • SEATTLE • OMAHA

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NEW ORLEANS

Sometime during the coming months the big eye perched on Palomar Mountain will open for its first glimpse into space. This mammoth 200 inch telescope—the largest in the world—depends on three ENTERPRISE Diesel-driven generating units for its complete power requirements. Over 300 miles of wiring inside Palomar's dome carry current to the delicate rotating mechanism, scores of robot controls, intricate lighting, pumping, clock and air-conditioning systems.

Where power failure at any time would stall and impair critical observations, much study of power applications was made by Palomar's great engineers and scientists. The selection of ENTERPRISE Diesels is indeed high testimony of the dependability and reliability of this power for such an exacting assignment.

You too will find in ENTERPRISE Diesels a flexibility of application to meet your special power requirements. We invite your investigation of the wide range of ENTERPRISE Models. Normally-aspirated or turbocharged up to 1800 HP per unit.

DIESEL ENGINES • PROCESS MACHINERY • OIL BURNERS • HEAVY MACHINERY

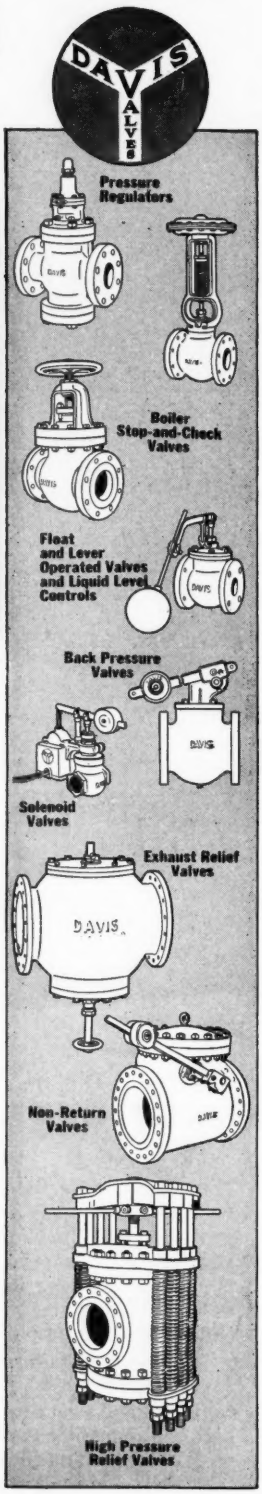
SOLENOID VALVES

Built for Heavy Duty Industrial Service

DAVIS industrial-type Solenoid Valves are no to be confused with ordinary, low cos commercial types. Davis products are engineered to handle the "tough jobs" on a basis of SATISFACTION GUARANTEED. The Davis line is complete—standard and special designs are available for every conceivable kind of automatic control application.

Our Engineering Department is always ready to assist in solving any problems regarding the use of Solenoid Valves. When submitting your problem, give complete information so that the proper valve may be selected for the service. State size of valve, whether globe or angle pattern, nature of fluid or gas, temperature, maximum and minimum pressures, service for which valve is to be used, whether valve is to be open or closed when solenoid is energized, standard or explosion-proof solenoid box and current characteristics.

No. 93 ***(illustrated above)*** is a self-contained, pilot operated, single seated, tight closing valve, built with full port opening to insure maximum flow with minimum pressure drop. Action is visible—may be operated by hand if current fails. Renewable valve disc. Sizes ½" to 4". Suitable for control service on steam, air, gas, water or oil lines.



DAVIS REGULATOR CO.

Representatives in All Principal Cities

S. WASHTENAW AVE., CHICAGO 8, ILL.

fields where Allis-Chalmers has already taken a leading role.

The new department will particularly pursue turbo-power developments for ships, locomotives and stationary plants, based on extensive past experience with Houdry gas turbine-compressors, the gas turbine drive aircraft superchargers and jet propulsion units, and an experimental 1500-F marine gas turbine unit built for the Navy.

WESTINGHOUSE PLANS SCHOOL

PLANS FOR A training program designed to help solve technical problems of the growing electric power industry were announced by L. E. Osborne, senior operating Vice President of Westinghouse, at the Electric Institute convention in Atlantic City.

This special training course for young utility engineers will last about eight months. It will be held in production aisles and laboratories of Westinghouse Electric Corp. plants. The course will be designed to give the young engineer who is entering the electric power industry basic training in manufacturing, engineering, and application of electric power equipment. The first group will be limited. A few young engineers from each section of the country will be included. From experience with this first group a pattern will be developed to train more men.

Ward Raymond, President of Pennsylvania Pump & Compressor Co., Easton, Pa., has resigned and is succeeded by Ellis R. Snovel, former Vice President. This change took effect in April.

Combustion Engineering Co., Inc., recently announced the opening of offices at 2140 Rand Tower, Minneapolis, with Frank J. Palm as representative in charge. Mr. Palm will operate the offices under the general direction and supervision of the company sales offices in Chicago.

A construction and expansion program to cost several million dollars has been announced for the Pittsburgh Works of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. The first major expansion of the Pittsburgh property since its purchase in 1927 by Allis-Chalmers will include a new 250 by 400 ft building which will be devoted largely to production of transformers, major item manufacturerd by the company at Pittsburgh. Another smaller building at the New River plant will be used for shipping.

Vulcan Soot Blower Corp., Du Bois, Pa., announces the appointment of Illes and Larkin, Cleveland, Ohio, Hebert and Co., Rochester, New York, and The Hawkins-Hamilton Co., Richmond, Virginia, as sales engineering representatives in their respective territories for the sale of Vulcan soot blowers.

The Hammel-Dahl Co. of Providence, Rhode Island, announces the appointment of Frank J. and Arthur T. Carr as New England Sales Representatives operating from Boston, Mass., as The Carr Bros. Co.

G. L. Pike, 10 Minnemere Street, Malden 4, Mass., has been appointed sales representative by Gibson Electric Co., Pittsburgh, Pa. His territory covers all of the New England States.

MANUFACTURERS' *Personals*

J. H. Bell, assistant vice president of Foster Wheeler Corp. and head of its public relations and advertising department for over two years, has been appointed sales manager of the company's newly-created Dallas District. Making his headquarters in Dallas, Mr. Bell will be in charge of a district that embraces parts of Texas, Oklahoma, Mississippi and all of Arkansas.

The Peter F. Loftus Corp., Consulting Engineers, of Pittsburgh, Pennsylvania, has

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Importance of Field Tests in Selecting Condenser Tubing

Operators are anxious to make the shrinking dollar go further by reducing maintenance and replacement expense, and by increasing the service life of all their equipment. Since surface condensers play such a vital part in the operation of every power plant, the importance of using the most suitable condenser tubing is generally recognized.

Selection of a condenser tube alloy which will give the most satisfactory results at the lowest cost per thousand service-hours is a complicated business which depends upon a great many factors. In order to help customers, Bridgeport maintains a consistent program of corrosion research. Through cooperation with power plant engineers in various parts of the country, we have found that the behavior of condenser tubing varies considerably.

Service Tests Valuable

Since the nature of cooling water and operating procedures are subject to variation, service and field tests are frequently carried out to aid in the selection of the most satisfactory tubing alloy. In order to minimize interruption in service and keep tests on a comparatively inexpensive basis, special racks are made up of sample strips of the alloys to be tested. Such a test rack, containing from 6 to 30 specimens, generally is suspended in the intake tunnel, as close as possible to the water box of the condenser, and submerged 12″ to 15″ below the low water level.

After the necessary time has elapsed (usually 1 to 2 years), racks are removed, carefully packed in exactly the condition in which they are found, and sent to Bridgeport.

Laboratory Examination of Samples

Test specimens are first examined for biofouling. Measurements are then made to determine any dimensional changes which have occurred.

The character of the corrosion is determined—thinning, pitting, impingement, etc. Samples are tested for loss in tensile strength.

All corrosion rate values are converted to mils per year, so that the extent of corrosion may be clearly stated in easily understandable form (see table).

Many Values Must Be Considered

Since inlet end corrosion of condenser tubing is the cause of early failure of some materials, it is necessary to place as much emphasis on the depth of impingement corrosion as on the extent of thinning based on weight loss. Ideally, the alloy selected to stand up under any given condition should have both of these values as close together as possible. This is particularly true with polluted waters. In some instances it may be necessary also to consider the effects of other types of failure, such as grooving, cracking, etc.

A Gulf Coast Experience

Corrosion tests were conducted in a Gulf Coast power plant (see table below) where Admiralty had not lived up to expectations, particularly in one condenser. Examination of the corrosion test data shown for the alloys tested at this plant revealed Duronze IV*, a special arsenical aluminum bronze, to be the best material, both from the standpoint of average corrosion rate as well as the impingement corrosion rate. It is quite obvious that the Duronze IV alloy should be markedly superior to Admiralty. The results are in accord.

The condenser was retubed with Duronze IV, and to date, after approximately 4 years, no failures have occurred. This condenser is now reported to be the best operating unit in the plant.

Alloy	Amount of Thinning Calculated From Weight Loss (Mils per year)	Depth of Impingement Corrosion, Inlet End (Mils per year)
Arsenical Admiralty	11.39	85.0
Duronze IV	5.00	5.8
Cuzinal	9.05	15.3
Cupro Nickel	11.03	89.0

Comparative Corrosion Resistance of Several Copper-Base Alloys to Sea Water at Gulf Coast Power Plant. Water chlorinated for slime control.

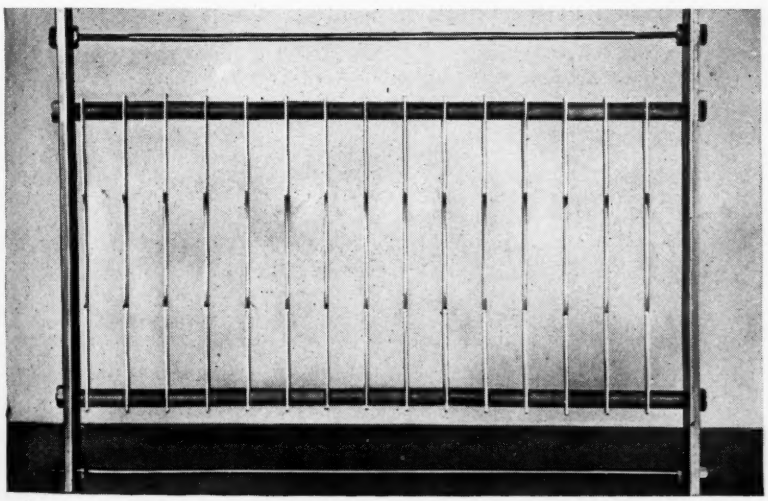
Other Tests with Duronze IV

Examination of the data obtained from several other locations where the water is polluted, either fresh or salt, indicates that Duronze IV makes a good showing. This alloy is not a "cure-all," but has stood up exceptionally well under rapidly flowing fresh or salt water, polluted by sewage and industrial wastes, acids, cinders and other foreign matter. It has been used successfully in plants where salt water is mixed with polluted fresh water, such as tidal estuaries.

Other Corrosion Resistant Alloys

Bridgeport manufactures a wide range of corrosion-resistant condenser tube alloys such as Duronze IV (aluminum bronze), Cupro Nickel, Cuzinal (aluminum brass), Arsenical Admiralty, etc. Bridgeport's corrosion research laboratory and technical service department are designed to help the power plant engineer choose the most suitable condenser tube alloy for his specific conditions. Contact the nearest Bridgeport office for this service and write for 112-page Condenser Tube Manual which contains much practical up-to-date information about corrosion research, condenser tube alloys, methods of installing and suggestions for increasing condenser tube life.

*U. S. Patent No. 2,093,380

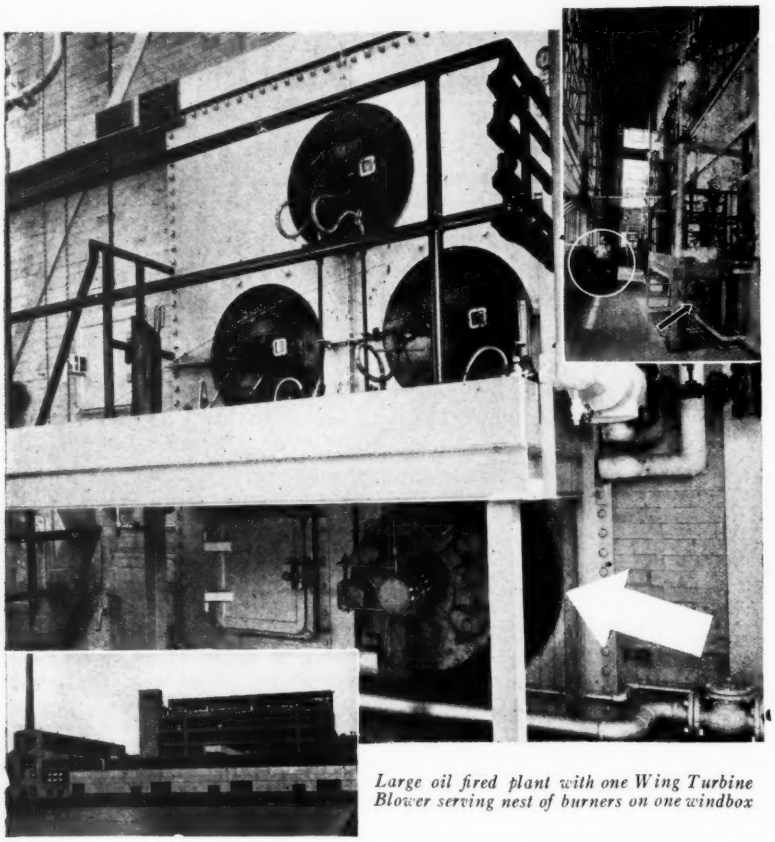


Corrosion Test Rack constructed of Duronze III end plates, rods and nuts with plastic insulators.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal



Large oil fired plant with one Wing Turbine Blower serving nest of burners on one windbox

Wing Turbine Blowers Save:

POWER COSTS—because they can be installed on windboxes thereby eliminating duct losses requiring higher initial driving power.

ENGINEERING LAY-OUT TIME AND EXPENSE—because there are no ducts to design and find space for with their cumbersomeness and expense.

MAINTENANCE—because of their utter simplicity. An occasional shot of lubricant to the two ball bearings plus a very infrequent take-up on packing glands is all that is required of routine handling. There is no more rugged machine in any power plant than a Wing Blower.

Write for Bulletin SW-1

L. J. Wing Mfg. Co. 64 Seventh Ave., **New York 11, N. Y.**

Factories in Newark, N. J. and Montreal, Canada

TURBINE BLOWERS • TURBINES • • FANS • MOTOR DRIVEN BLOWERS
REVOLVING UNIT HEATERS • UTILITY HEATERS • FIXED DISCHARGE UNIT HEATERS
DUCT FANS • DRAFT INDUCERS • HEATER SECTIONS • SHIP VENTILATORS • FOG ELIMINATORS

announced the addition to its staff of Edward T. Moore and Charles B. Cochran. Mr. Moore, a graduate electrical and mechanical engineer, received his technical education at Syracuse University and The Ecole Des Sciences, Paris. Mr. Cochran is an engineering graduate of Ohio State University.

Carl C. Nelson, works manager in charge of factory production, and James DeKiep, chief engineer, Electric Machinery Mfg. Co., Minneapolis, Minn., have been named to the company's board of directors. Mr. Nelson has been with Electric Machinery since 1930, serving first as manager of the control and switchgear division. Mr. DeKiep spent seventeen years in the design and application of a-c motors and generators before joining E-M in 1945 as chief engineer.

The Babcock & Wilcox Co. announced recently two administrative changes for its Barberton (Ohio) Works. G. J. Hartnett, Jr. will become Superintendent of Planning; M. Neilson will become Superintendent of Production.

E. T. Erickson, for the past three years Chemical Engineer in the Industrial Water Treating Division of the Dearborn Chemical Co., Chicago, has been placed in charge of the Chicago City Sales Department.

Fisher Governor Co. announces the appointment of G. W. Beecroft and Co., Toronto, as sales representatives for the Province of Ontario. Mr. Beecroft retired from the Canadian Army last year with the rank of Colonel after almost seven years' service with the Royal Canadian Electrical & Mechanical Engineers. He is a graduate of the Uinversity of Toronto and has had extensive experience with the International Petroleum Co., Ltd., in South America and in the petroleum industry in Canada.

Link-Belt Co. announces the appointment of Mr. Robert C. Bercherer to the position of Plant Manager of the Ewart plant in Indianapolis. Warren H. Maxwell, formerly superintendent of the positive drive shop of the Ewart plant, has been appointed General Superintendent. Mr. Maxwell has been with the company since 1922. S. L. Houck becomes Asst. General Superintendent of the Ewart plant. Carl O. Schopp has been appointed Superintendent of the Ewart plant foundry.

Joseph M. Weldon has been appointed Assistant to the Vice President of The International Nickel Co., Inc., it has been announced. He will be Assistant to H. J. French, Vice President. Mr. Weldon became associated with International Nickel in 1927 when he joined the Inco Nickel Alloys Sales Department. He has been head of the Aeronautical Division of that Department since November, 1945.

Hugh J. Fraser, Vice President of The International Nickel Co., Inc., has been placed in general charge of all plant operations of the company in the United States, according to a recent announcement. John A. Marsh, Assistant General Manager of the Huntington (West Virginia) Works, has been appointed Mr. Fraser's assistant, with the title of Assistant to the Vice President.

Appointment of John A. Worthington as General Sales Manager of the Piston Ring Division of Koppers Co., Inc., was announced recently. At the same time, it was announced that T. Latimer Ford, who has been with Koppers or its affiliates since 1908, and has become widely known in the piston ring field, will head up a new company department devoted exclusively to replacement sales.

E. H. Vockrodt, of 3757 Wilshire Blvd., Los Angeles 5, California, has been appointed Pacific Coast Representative by Alloy Steel Products Co., Linden, New Jersey.

Henry W. Kayser has recently assumed new responsibilities at The Falk Corp. with his appointment as Supervisor of Development Engineering. In connection with his enlarged duties, Mr. Kayser will be available for field consultation, when the occasion de-

RUST PREVENTION

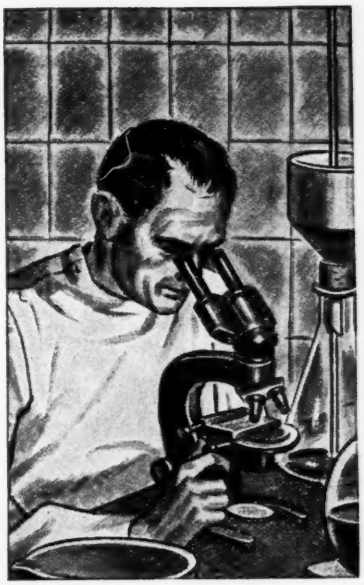
$100,000 Worth of Hand Tools saved from "RUST"

NEW PRODUCT DOES THE JOB AFTER PLANT CONDUCTS EXHAUSTIVE TESTS

Lubrication Engineer's Report

"Some time ago, we were called in by a prominent manufacturer.* Corrosion of all metal parts in his entire plant had gone out of control. The machine shop and hand tools, valued in excess of $100,000, were a sorry looking 'dusty-brown.' Everything they had used in the way of rust preventives heretofore failed to solve their difficulty.

"After studying their problem we recommended our General Purpose Anti-Corrode No. 100 and suggested that they give it exhaustive tests. Their chemist did so and we are happy to report that it solved their problem.



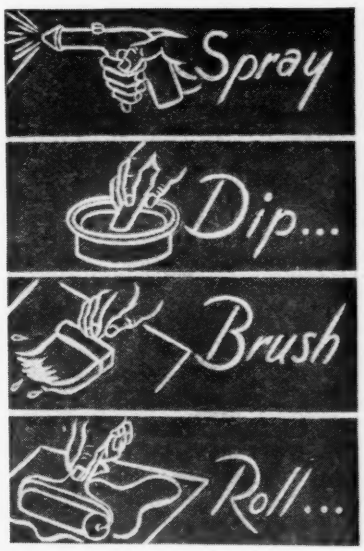
Used on Hand Tools As Well

"They have since used over 150 gallons of this Anti-Corrode on everything metal in their plant, including small hand tools such as pliers and screw drivers."

Anti-Corrode No. 100 is one of several new types of Cities Service protective coatings for metals. Designed to prevent corrosion of raw stocks, finished parts and completed machines, it adheres firmly, displaces moisture and protects longer than many materials now on the market.

Easy To Apply

Apply Anti-Corrode by ordinary work-shop methods. Spray, dip, brush or roll it on. The protective film is continuous and non-porous—does not break at sharp edges nor rupture on flat surfaces. It need not be removed from metal to be stamped, drawn or otherwise formed.



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Cities Service will demonstrate the many advantages of Anti-Corrode to you in your own plant. Contact the branch office nearest you or write Cities Service Oil Co., 60 Wall Tower, New York 5, N. Y.

Name on request

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(This offer available only in Cities Service marketing territories East of the Rockies.)

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Gentlemen: I'd like to test ANTI-CORRODE No. 100 on my own equipment FREE OF CHARGE. Send me details.

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mands. He has been associated with The Falk Corp. as designer, Application Engineer, and Development Engineer since his graduation from the Marquette University College of Engineering in 1931. He has also been active in local and national engineering societies, particularly the American Gear Manufacturers Association in which he now serves as chairman of the Helical and Herringbone Gear Committee.

Election of Paul W. Eberhardt to the Board of Directors of Walter Kidde & Co., Inc. was announced recently. Mr. Eberhardt has been associated with the Kidde Co. for twenty-one years and, since 1945, has been a Vice-President. Recently he was elected President of the Fire Protection Institute. He has long been recognized as one of the nation's top authorities on fire protection.

J. A. Zurn Mfg. Co., Erie, Pa., announces the appointment of Albert A. Sterling, Jr. as district engineer with headquarters in Houston, Texas. In his most recent connection, Mr. Sterling was sales manager with the Brance-Krachy Co., Inc. Previous to his three years in the Navy, he held the position of sales engineer with Ingersoll-Rand Co.

Mason-Neilan Regulator Co. has announced the appointment of John W. Brown, sales engineer, as manager of its San Francisco office located at 198 Second St. Mr. Brown is a mechanical engineer, formerly with the Instrument Department of Standard Oil Co. of Ohio. He came to Mason-Neilan in 1945, spent over a year in the Engineering Department, then became sales engineer in Mason-Neilan's Pittsburgh office.

H. W. Walters, formerly assistant works manager at Pittsburgh, has been named works manager of the Allis-Chalmers Mfg. Co. Boston Works, according to a recent announcement.

The John Waldron Corp., New Brunswick, N.J. has announced the appointment of Thomas H. Latimer as Executive Engineer in charge of engineering, drafting, and estimating. Prior to assuming his new duties, Mr. Latimer, a Cornell University graduate, was Chief Engineer of the Black-Clawson Co., Hamilton, Ohio, with whom he had been associated for the past ten years. Previous connections with the paper industry were with the Rice Barton Corp, Minton Vacuum Dryer Corp., and the Jessup & Moore Paper Co. He is a brother of Homer H. Latimer, of the Champion Paper & Fibre Co.

Leslie Co., Lyndhurst, N.J., has announced the appointment of the following agents to handle industrial sales and service: The Sherwood Bishop Co., 413 Woodland Street (Manchester) Hartford, Conn. and Harold W. Frederick Co. N 213 Division Street, Spokane, Wash.

Karl J. Ratliff has been named resident representative for Allis-Chalmers' general machinery division at Forth Worth, Tex. Mr. Ratliff, who joined Allis-Chalmers in July, 1945, had previously served as sales engineer in the company's Houston and San Antonio offices.

J. H. Burrus has been named assistant manager of the Allis-Chalmers Portland district office, according to an announcement by J. L. Singleton, manager of district offices. A member of the American Institute of Electrical Engineers, Mr. Burrus was associated with Allis-Chalmers Charlotte, N.C. office before coming to Portland, Ore. F. V. Sams continues as manager of the Portland office.

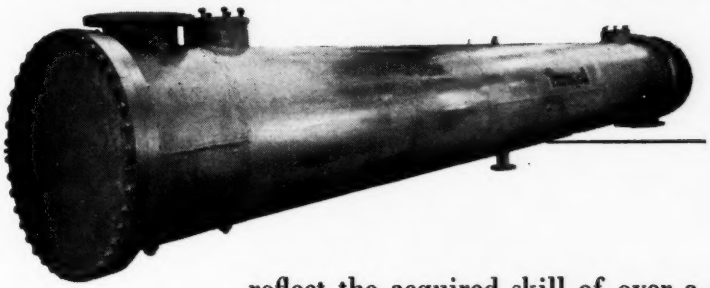
Link-Belt Co. announces re-establishing a sales office in Washington, D.C., at 1009 Washington Gas Light Bldg., located at 11th & "H" Sts., N.W., Washington (1), with C. R. Heller, Washington Representative, in charge. Mr. Heller's duties will be confined to work with Foreign Purchasing Commissions and with the Governmental and Armed Service Bureaus located in Washington. Industrial sales in the District of Columbia will continue to be handled by the company's office in Baltimore.

ALL Paracoil FUEL OIL HEATERS

Whether for the small heating plant

6D48-5 U-Tube Type Fuel Oil Heater. Below Water Line Service. Capacity (No. 6 oil) 116 GPH 90°F.-150°F. Boiler Water 212°F. Weight 175 lbs.

or for the huge bulk storage terminal



AF-288D Straight Tube Type Fuel Oil Heater. Bulk Station Service. Capacity (No. 6 oil) 120,000 GPH 100°F.-160°F. Steam at 15 PSIG. Weight 12 tons.

reflect the acquired skill of over a quarter of a century's close application of doing one thing well. PARACOIL has been building good oil heaters of every type and size—for every service—since 1915. Major oil burner companies have recognized the soundly based designs behind these PARACOIL heaters and are flatly specifying them to their dealer and distributor organizations. Write for your copy of our new Bulletin 60 for the reasons why.

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All our products are distributed through licensed agents in principal cities throughout the country. There are some lucrative areas still open for aggressive active sales organizations. Write for details.

Our new bulletin No. 60 is just off the press. Full of engineering data, capacity charts, dimensions and installation diagrams of our complete line of Preheaters. Write for your copy on your letterhead.

Note: Most all PARACOIL heaters are now in stock. For quick deliveries check with PARACOIL.

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It tells with sketches and few words how the "Flexitallic" art which established itself in wide use through safe performance has now put safety on a new level.

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ORIGINATORS OF SPIRAL-WOUND GASKET CONSTRUCTION

8th & BAILEY STREETS CAMDEN, N. J.

New ENGINEERING BOOKS

Personality and English in Technical Personnel, by Philip B. McDonald; 424 pages, size 6 by 9 inches, cloth binding; published by D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York, price $3.75.

Those familiar with the author's former book "English and Science" will find here some material revised and brought up to date from that earlier book, but on the whole will find a great deal more. Here is another illustration of the way in which it is almost impossible to talk about the language problems of technical men without talking about what kind of men they are. Professor McDonald, the head of the Department of English in the College of Engineering of New York University, has interspersed many shrewd observations on what engineers and technicians are like with much practical information on what they need to solve their writing and speaking problems.

He begins by pointing out that the technical specialist has certain faults and peculiarities and that his personality is an outstanding problem not only for himself but for industry as well. He points out that it is often very difficult for technical specialists to take the long view of things and to prevent the daily routine from dulling their imaginations. Personal grievances too, he says, may obscure their larger development. Following this discussion he has some very practical things to say about how technical libraries offer many constructive suggestions. He then points out that too few technicians make good reports and discusses the types of reports and the types of readers to whom they are addressed. The technician should leave a record of his work and the detailed types of reports are next considered.

In Chapter 2 on Writing and Presenting a Technical Paper, the author discusses considerations for the reader, preliminary outlines, starting the paper, style of the paper, ear-marks of the novice or veteran, professional jargon and other technical points. Another chapter discusses the style of report for various types of readers, most of whom are busy officials. Chapter 13 discusses good Letters and Bad, while Chapter 15 correctly condemns Obscurity, Pomposity, and Ornateness. Chapters on sentence structure and punctuation follow and then there is a chapter on How Language is a Test of Personality, which brings out principally the point that carelessness in punctuation or grammar often indicates defects in thinking.

There is a chapter on Anthrology, a new cultural interest, which traces human progress from savagery to civilization and is literally the science of man. In Chapter 31 he points out how and why some people are still medieval minded and his concluding chapter is an interesting discussion of why certain technical applications fail unnecessarily.

In short, a sound balance between the over-specialization of the technician and the too broad background of the non-technician will probably lead to the highest development of personality.

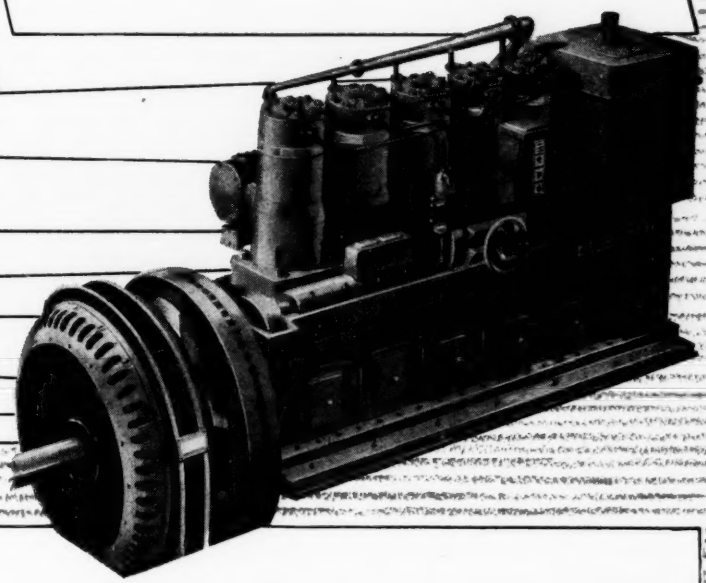
The Engineer in Society, by John Mills; 196 pages; size 5½ by 8 inches; cloth binding; published by D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York; price $2.50.

The author of this book is a well known interpreter of science to the layman, having published many magazine articles on various technical subjects and written two fine books "A Fugue in Cycles and Bels" and "Electronics: Today and Tomorrow." The present book, he says, started out to be a discussion of the problems engineers need to solve in publishing and writing technical material so that ordinary people can understand it.

However, the book soon turned into a discussion of what kind of man the engineer is and what his place is in society. For those two things, more than anything else, determine

In Case After Case,

FAIRBANKS-MORSE DIESEL PERFORMANCE IS PROVED



It's the usual thing for Fairbanks-Morse Diesels to turn in consistently outstanding records of performance. Time and again, users in every industrial field report low maintenance, low fuel cost, and dependable operation under sustained, heavy-duty service, with Fairbanks-Morse Diesels.

It is an outstanding combination of diesel performance features—but it is all the more outstanding when you know that Fairbanks-Morse Diesels continue operating this way, year in and year out. Their performance records prove this conclusively.

What Fairbanks-Morse Diesels have done elsewhere, they can do for you, too. Remember—diesels, above all other power sources, deliver the most energy per gallon of fuel oil. Write today for the complete story of Fairbanks-Morse Diesel economies. Fairbanks, Morse & Co., Chicago 5, Illinois.

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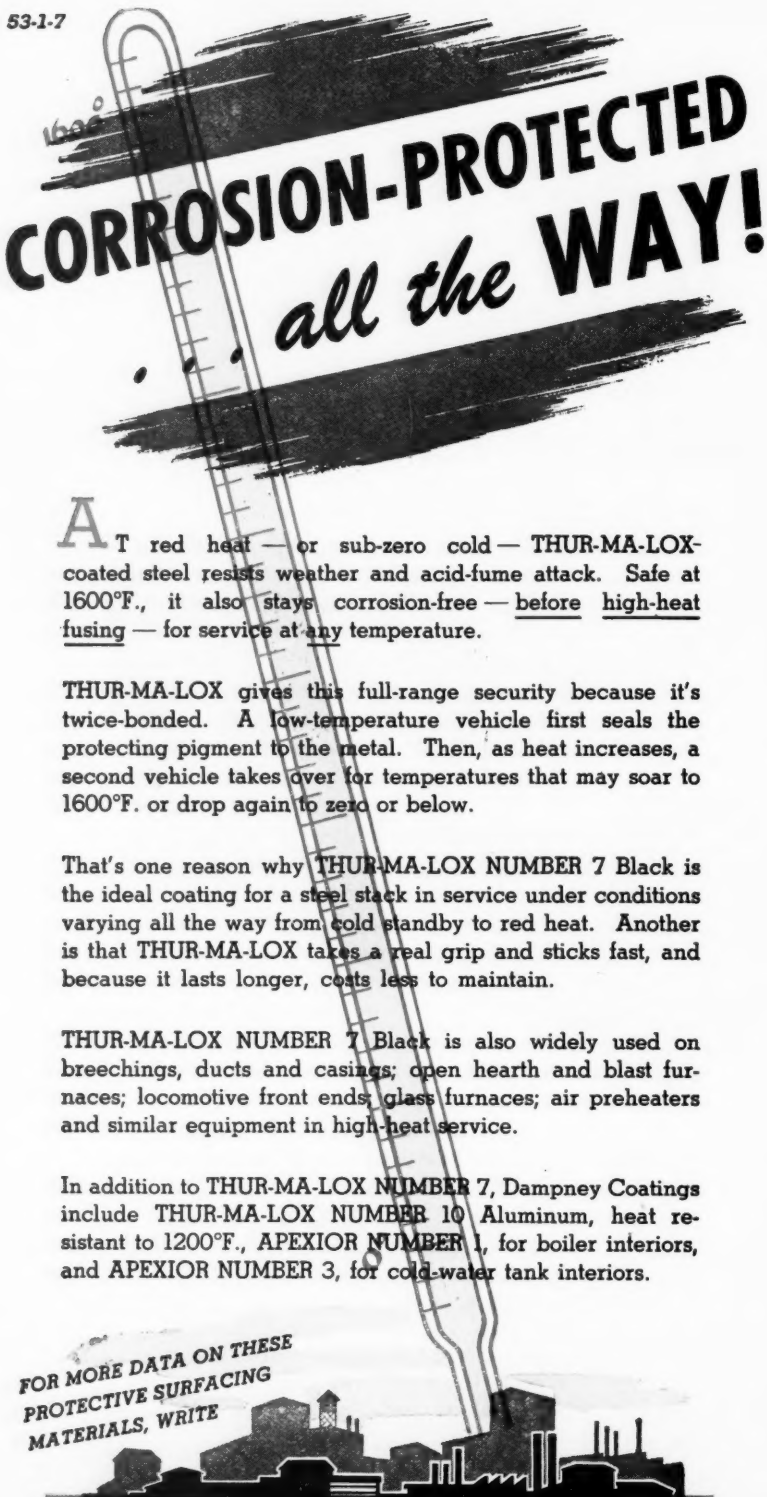

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AT red heat — or sub-zero cold — THUR-MA-LOX-coated steel resists weather and acid-fume attack. Safe at 1600°F., it also stays corrosion-free — before high-heat fusing — for service at any temperature.

THUR-MA-LOX gives this full-range security because it's twice-bonded. A low-temperature vehicle first seals the protecting pigment to the metal. Then, as heat increases, a second vehicle takes over for temperatures that may soar to 1600°F. or drop again to zero or below.

That's one reason why THUR-MA-LOX NUMBER 7 Black is the ideal coating for a steel stack in service under conditions varying all the way from cold standby to red heat. Another is that THUR-MA-LOX takes a real grip and sticks fast, and because it lasts longer, costs less to maintain.

THUR-MA-LOX NUMBER 7 Black is also widely used on breechings, ducts and casings; open hearth and blast furnaces; locomotive front ends; glass furnaces; air preheaters and similar equipment in high-heat service.

In addition to THUR-MA-LOX NUMBER 7, Dampney Coatings include THUR-MA-LOX NUMBER 10 Aluminum, heat resistant to 1200°F., APEXIOR NUMBER 1, for boiler interiors, and APEXIOR NUMBER 3, for cold-water tank interiors.

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THE DAMPNEY COMPANY OF AMERICA

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largely the way in which he expresses his ideas.

It should not have required the development of an atomic bomb to direct attention to the political importance of science and engineering, the author points out. Yet these recognitions are by-products which may prove to be more influential than the bomb itself. Science, he maintains, has in its methods and objectivity a promising, untried technique for the solution of social problems which have been amplified by the elimination of remoteness from geography. It will take time to organize scientists and engineers for this task and to obtain public acceptance of their efforts. If this book can help to shorten the time, it will have fulfilled the hopes of the writer.

He begins by discussing what manner of men engineers are and what their function is in society. Most people are either S or D types and the author's proof of why a man is either an S type, who sees similarities between things, or a D type who sees differences, is important in finding out whether or not a man belongs in the proper group in industry. This leads to a consideration of the wrong man for the right job and of just what engineering aptitudes consist of. This is based on a great deal of work the author did in recruiting new members for the technical staff in Bell Telephone Laboratories. (He has been with the telephone organization in one capacity or another for the past 35 years and before that was a university teacher for 10).

He then discusses the dietetics of jobs, showing what proportions of individual, creative, mental and physical routines and of collective work, involving contacts with superiors, equals or inferiors, constitutes a balanced ration in work. He then discusses the attitudes of research workers. The second part of the book deals with Scientists Gone Executives. Then come chapters on Salary Progress for Scientists, scientific Labor and Management, Scientific Men of Good Will, Organizing for Evolution.

The latter part of the book begins to deal more with some of the details of the engineer's writing and speaking. There is a chapter on the Art of Thought, The Curve of a Growth, followed by a chapter on Persuasive Exposition.

Too many engineers says Mills, think it beneath the dignity of their profession to make their conclusions effective by good writing. Persuasive writing is not necessarily dishonest. Yet when the facts are known and honest conclusions are drawn from them, it is an advantage to society to have them put into effect. Persuasive writing is little more than clear writing, which makes all the difference It persuades to comprehension.

The last two chapters deal with ways of obtaining clarity of expression in speaking and writing and with methods for considering how the reader will receive what you write. Clear thinking, good thinking, good intention, simple sentences, their rearrangement with reference to the reader over ones shoulder and then knowing when to quit—those are what Mills recommends for purposeful exposition.

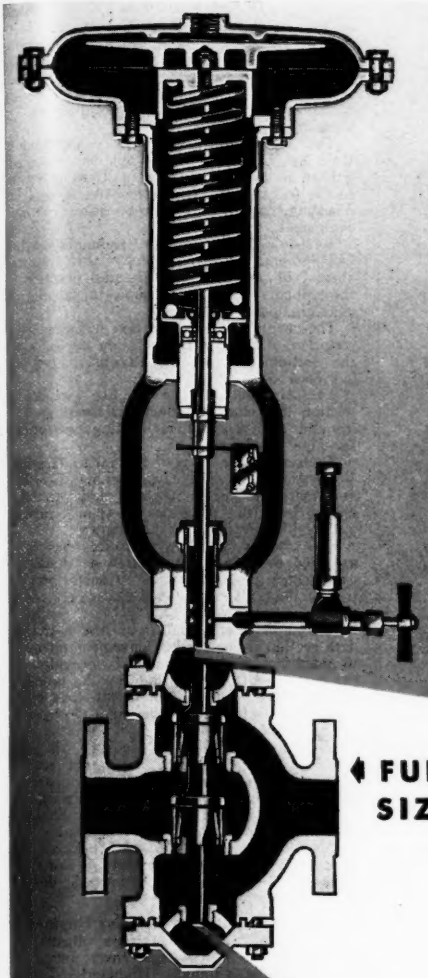
Heating, Ventilating, Air Conditioning Guide 1947; 1280 pages, illustrated; size 6 by 9 in., cloth binding; published by American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York 10; price $6.00.

The 25th edition of the well-known Heating Ventilating Air Conditioning Guide is announced, its silver anniversary edition.

All of the 51 chapters of The Guide have been reviewed by The Guide Publication Committee assisted by a group of 50 practicing engineers and other authorities who served with the committee. Important changes have been made wherever improvement could be effected either in presentation of material or in addition of useful data.

The chapter on Cooling Load has been rewritten and includes an enlarged list of cities for which summer design conditions are given. Methods of determining components of heat and vapor gain are given in detail for homogeneous and composite walls. A detailed example in determining cooling load is included.

Treatment of Fuels and Combustion has been enlarged. Formulas for heat charts are included for easy determination of flue gas



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The introduction of Fisher's new restricted inner valves offers a quick, economical and completely satisfactory way to reduce the effective capacity of a larger nominal valve size.

INTERCHANGEABLE

FULL SIZE

1 SIZE SMALLER

2 SIZES SMALLER

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For example, a 4" valve can quickly be converted to flow capacity of a 3" 2½", or 2" size. This is accomplished by the restricted V-Port Inner Valve alone—without changing seat rings. Inner valves with equivalent smaller size valve area or capacity are fully interchangeable with standard full size inner valves. Inner valve skirts are cast stainless steel with wide range percentage characteristics port areas. Cast skirts are welded on to stainless steel bar stock center post guide. Further details and application data gladly furnished on request.

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"THE UNBREAKABLE GAUGE GLASS"

Be Sure of "BULLS-EYE" Visibility at the Water Line

REFLECTING SONDERGLASS goes a big step further in promoting safety in boiler rooms. It has all the advantages of "clear" SONDERGLASS plus a red and white enameled back which gives the water line "bulls-eye" visibility, even in dark places. . . . You'll find this gauge glass economical, too, because it will not discolor and saves frequent renewals.

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IS a factor to consider

BEGIN BY MINIMIZING STEAM LOSSES . . .

Investigate the STERLING STEAM ECONOMY LIFTER!

An automatic device which stops hidden steam losses in any steam producing plant. Results shown on new or old installations.

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Laundries — Textile Service

Sterling Engineering & Mfg. Corp.

(Templeton Mfg. Co.) 117 Business St.

Hyde Park, 36 Massachusetts

losses. In the chapter on Hot Water Heating Systems and Piping, examples in piping design have been simplified. A formula for sizing closed expansion tanks has been added. Information on use and installation of air cleaners has been added to the chapter on Air Cleaning Devices.

The chapter on Unit Air Conditioners, Unit Air Cleaners, Attic Fans has been rewritten to include improved sections referring to the features of construction and factors influencing operation and application of unit equipment.

Revision of the chapter, Dehumidification by Sorbent Materials keeps this chapter abreast of present knowledge and practice in the sorbents field. An example in calculating moisture load is included.

The chapter on Refrigeration includes a description of the air refrigeration cycle; also, the section referring to absorption systems has been simplified.

The Air Duct Design chapter includes a friction loss chart for ducts as small as 1½ in. and a new chart facilitating corrections for pipe roughness.

Revision of the chapter on Marine Heating, Ventilating and Air Conditioning provides new material based on Navy and merchant marine practice. Diagrams of typical marine air conditioning systems are shown.

The chapter on Water Services has been extended to include information on design of cold water piping systems. Charts provide friction loss for both rough and fairly rough pipe.

A complete cross-index of the technical data section is included. Convenient reference to manufacturers' equipment is provided by the catalog data section showing the products of 240 firms, with a convenient cross-index of products available. The guide includes a roll of membership of the Society.

As in the preceding 1946 edition, the subjects treated are grouped in several general sections, under which they are divided into chapters. The sections: Cover: 1—Principles; 2—Human Reaction to Atmospheric Environment; 3—Heating and Cooling Loads; 4—Combustion and Consumption of Fuels; 5—Heating Systems and Equipment; 6—Air Conditioning; 7—Special Applications; 8—Instal lation of Testing Codes.

Practical Design Handbook for Engineers, by Dr. Alois Cibulka; 501 pages, illustrated; size 9½ by 12 inches, paper cover; published by Dr. Alois Cibulka, Highlands, Texas; price $6.00.

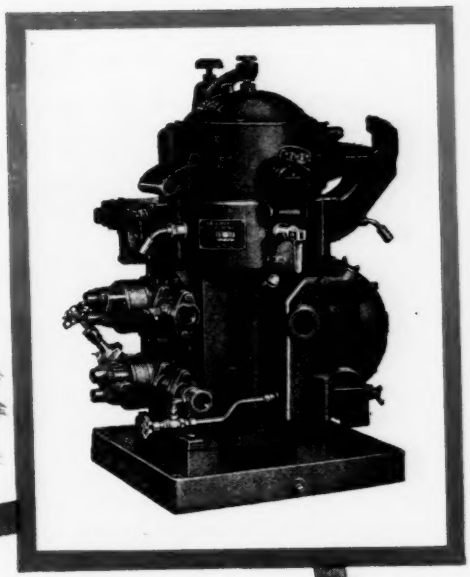
Calculus for Practical Engineers, by Dr. Alois Cibulka; 100 pages, illustrated; size 9½ by 12 inches; paper binding; published by Dr. Alois Cibulka, Highlands, Texas; price $3.00.

The first of these books, the Design Handbook, is one of the most interesting compilations of engineering information we have seen. The author quotes as his motto the dictum of Marcus Aurelius: "Do not act as if you had a thousand years to live." Acting on that maxim, he write the book for those engineers, including himself, who like to do the most in the shortest possible time and then go fishing or otherwise enjoy life.

The Design Handbook is primarily a compilation of all the fundamental principles, tables of data, and dozens of charts, required in several important fields of design. Part I covers the general theory and practical calculations for concrete, steel, and timber structures and steel and aluminum shapes. For example, while the principles of calulating loads on concrete and steel columns are given concisely and effectively, at the same time full-page, easily-read charts are presented. From these, knowing the unsupported length and the size of the column, you can read the safe load in thousands of pounds. Complete tables from standard sources and manufacturers' publications are given for all structural shapes, many specific problems are worked out in re-enforced concrete design, such as design of chimneys, concrete tanks, etc. Full details of structural steel design are presented by tables, standards formulas and charts. Several pages show diagrams of various types of steel structures and give the formulas for calculating moments, joints, etc.

Part II is devoted to a discussion of mod-

Purify New Turbine Oil and Prevent DETERGENT ACTION



WHEN turbine oil is changed, the new turbine oil has a detergent action. It picks up deposits of sludge and sediment that may have settled out from the old oil in the turbine reservoir and piping. The best way to prevent damage by this picked-up material is to remove it from the oil by centrifugal force before it can circulate through the system.

A De Laval Oil Purifier is the most foolproof way of keeping turbine lubricating oil clean. In the bowl, or purifying member, both the solid impurities and any moisture that may get into the oil are instantaneously separated out. Removed water is discharged continuously, and dirt is stored in the bowl, out of the zone where purification takes place.

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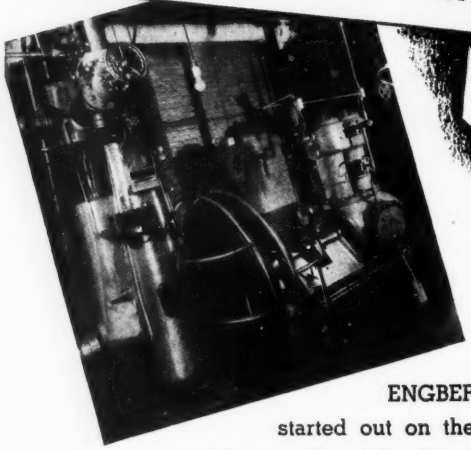
FOR MORE DEPENDABLE POWER PRODUCTION

TROY-ENGBERG STEAM ENGINE

THE STANDBY DRIVE

that soon became

THE MAIN DRIVE



Here is a TROY-ENGBERG STEAM ENGINE that started out on the second team but just wouldn't stay there! This 10" stroke Type E vertical unit hooked up to a well-known ice machine was installed in SIEBEN'S BREWERY CO., CHICAGO as a standby unit for a large horizontally driven machine. After a test run it was discovered that the TROY-ENGBERG unit could carry the load with the same or less steam consumption than the larger and supposedly more economical unit. Now the TROY-ENGBERG unit carries the full load and the big unit is relegated to the standby status.

If you use steam for heating or processing, you too can probably cut steam costs, which means power costs, by installing a TROY-ENGBERG Steam Engine and using By-Product Power to drive stokers, generators, compressors, pumps or blowers.

Send for Bulletin 306.

TROY ENGINE & MACHINE COMPANY

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STEAM ENGINES • GENERATING SETS • GENER

ern welded steel structures and to the "RST" system of re-enforced-steel-timber construction invented by the author, who is also head of the RST Engineering Co. He shows how this system of construction can be adapted to bridges, roofs and many other types of structures. His discussions of steel work and concrete construction are illustrated with detailed diagrams and tabulations of the factors involved. A number of pages are devoted to a study of rigid frames and statically indeterminate structures.

Part IV covers pressure and vacuum vessels and piping, giving charts for heads and shells of pressure vessels, data on pressure piping, transite pipe, lead pipe, equivalent flow capacity of pipes, condenser tube data, etc. In this section, special emphasis is laid on the design of piping used in chemical plants and oil refineries.

Tables and standard dimensions for all types of valves and pipe fittings, based on the Code, also standard fittings shown in the Crane and other handbooks, are given in detail.

Part VI gives detailed data on shafts, gears, belts. Part VII covers hydraulics, pumps, heat transfer, insulation, steam, ammonia. Properties of steam, vapor and fluids are shown, with many of the practical design tables, charts of pumping data and the like. Part VIII covers the characteristics and engineering factors required in dealing with oils, hydrocarbons and chemicals. Part IX covers aerial cable, tram ways, drilling rigs and guy lines and Part X gives mathematical tables, conversion tables, curves, construction of monographs, hyperbolic functions, tables of integrals, etc.

The author emphasizes designing not only for proper strength and function, but with forethought to prevent obsolescence and also with thought to the convenience of the men who must operate the equipment.

The author's other book on the calculus is designed to explain integration and differential equations clearly and rapidly, and shows how the processes of the calculus can be used in solving actual engineering problems.

Concise Chemical and Technical Dictionary, Edited by H. Bennett; 1055 pages, illustrated; size 6 by 9 inches, cloth binding; published by The Chemical Publishing Co., Inc., 26 Court Street, Brooklyn 2, New York, price $10.00.

Written for both professionals and laymen, this book contains definitions of many internationally accepted terms. It contains data useful to many people in the business world who see technical expressions freely used in newspapers, magazines and advertisements, and need to know their meanings without the necessity for a complete technical education. To the chemist and technician also, the book should be useful in promoting general understanding in various countries.

General rules for pronunciation of the chemical terms recommended by the ACS and a list of key words with phonetic spelling are features of the book. Another special feature is the listing of thousands of trade names or proprietary products in the synthetic resin, plastic, metal, rubber, textile, food, pharmaceutical, paint and varnish fields.

Conversion tables, discussion of indicators, chemical elements, vitamins, are also given. Under definitions of the words, many helpful cross references are included and arranged so that the desired terms can be located easily.

Chemical composition, uses and properties of a trade name or proprietary product are given in many cases. The book contains a wide variety of information about newly developed synthetic chemicals, important manufacturing processes, raw materials, terms used in radio and television engineerng, descriptions of every common or rare chemical.

Proceedings of the Mexican-American Conference on Industrial Research, Copyright 1946, size 6 by 9 inches, 176 pages, paper binding, published by The Armour Research Foundation of Illinois Institute of Technology, price, $2.50.

This volume contains the Proceedings of the Mexican-American Conference on Industrial Research held under the auspices of Armour Research Foundation, September 30

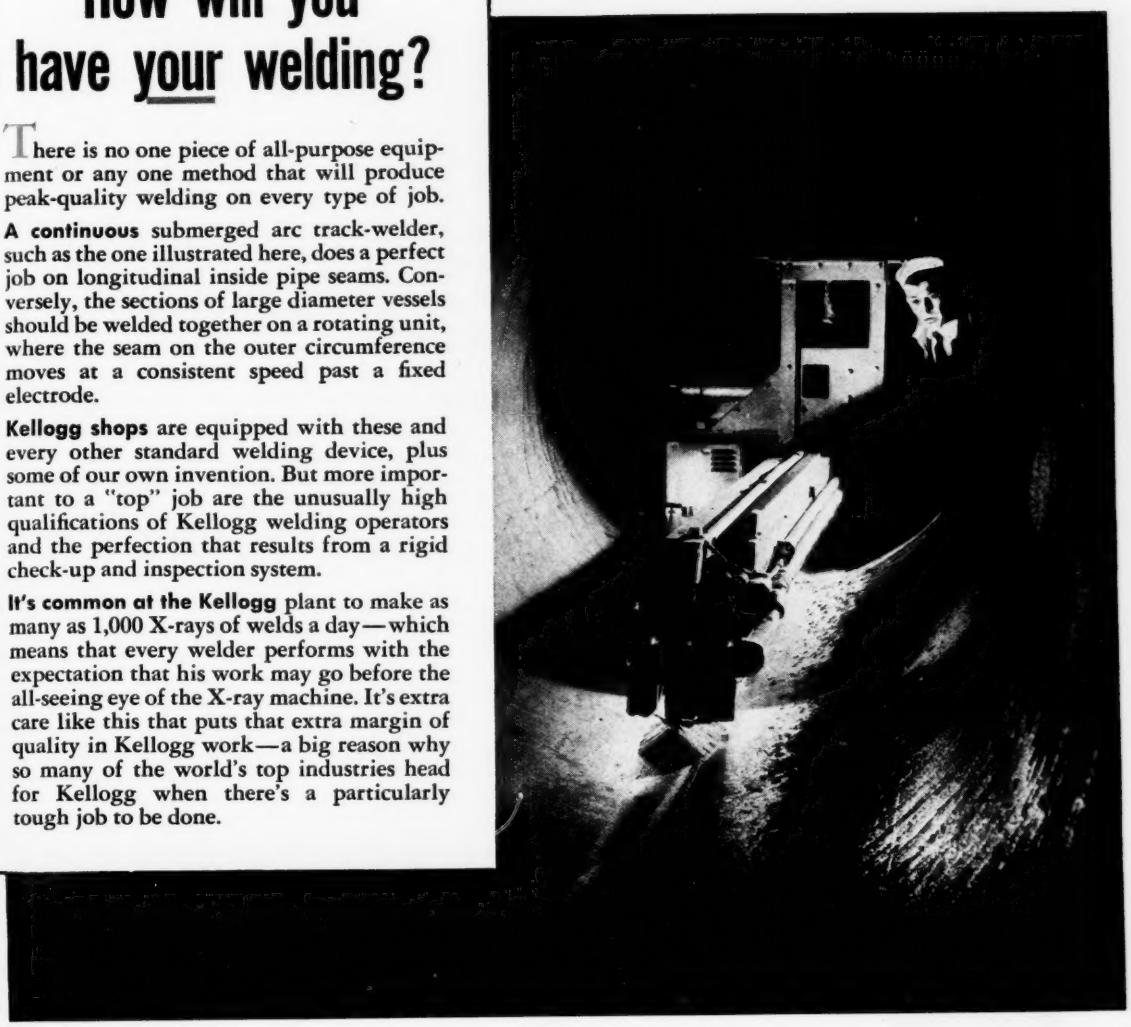
How will you have your welding?

There is no one piece of all-purpose equipment or any one method that will produce peak-quality welding on every type of job.

A continuous submerged arc track-welder, such as the one illustrated here, does a perfect job on longitudinal inside pipe seams. Conversely, the sections of large diameter vessels should be welded together on a rotating unit, where the seam on the outer circumference moves at a consistent speed past a fixed electrode.

Kellogg shops are equipped with these and every other standard welding device, plus some of our own invention. But more important to a "top" job are the unusually high qualifications of Kellogg welding operators and the perfection that results from a rigid check-up and inspection system.

It's common at the Kellogg plant to make as many as 1,000 X-rays of welds a day—which means that every welder performs with the expectation that his work may go before the all-seeing eye of the X-ray machine. It's extra care like this that puts that extra margin of quality in Kellogg work—a big reason why so many of the world's top industries head for Kellogg when there's a particularly tough job to be done.



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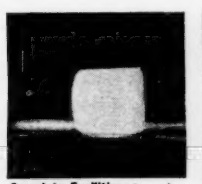

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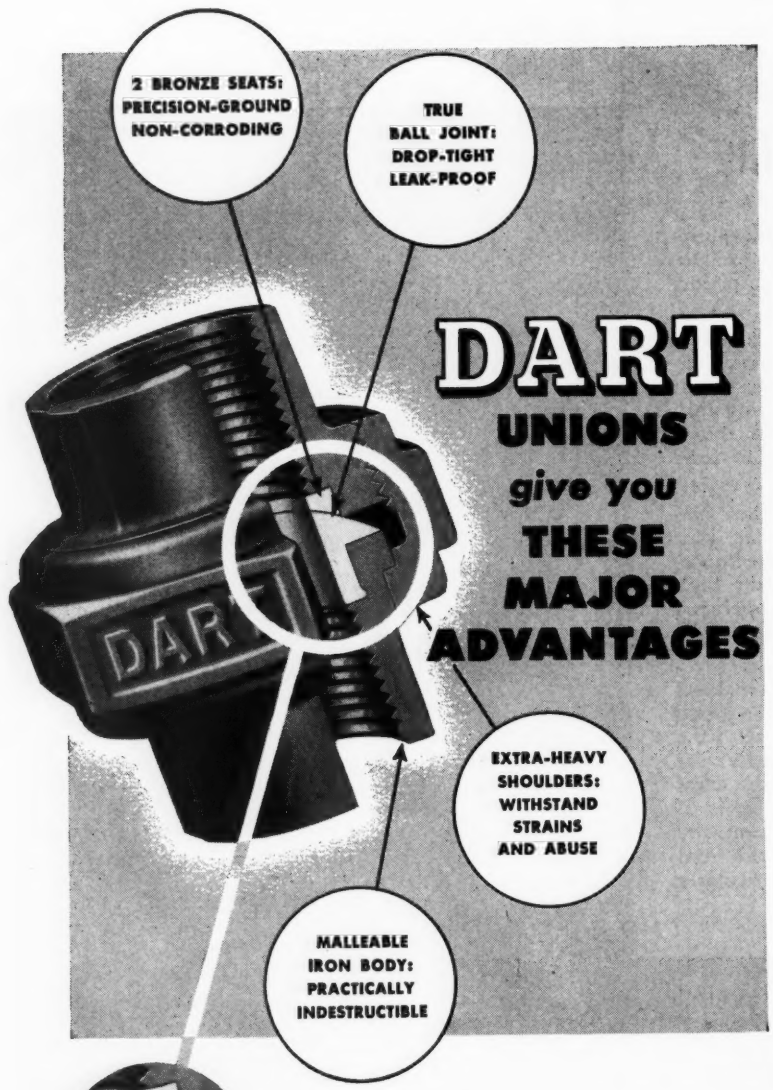

Dart Unions close tight and *stay* tight. There's no leaking . . . no jamming . . . no stretching . . . because they have two bronze seats which form a true ball joint—all housed within a body of malleable iron that is practically indestructible. These major advantages give longer life and greater economy. They enable Darts to be uncoupled easily and used over and over again in different locations.

Your supplier will be glad to show you why Darts are a *sound union investment.*

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DART UNIONS

to October 6, 1945. This Conference was the first to be held on industrial research between any two industrial nations. Its purpose was to demonstrate research in action from pure science at the University of Chicago to the typical laboratories of industry. The position and contribution of the government in national research activities were illustrated by a visit to the Forest Products Laboratory in Madison, Wisconsin. The participation from Mexico was representative of government, with a number of distinguished departmental engineers personally appointed by President Comaches of banking, of industry and of commerce. Two or three corporation lawyers and the Minister of National Economy were included in the delegation. The addresses and discussions included: The Industrial Research Pattern of the United States, by Harold Vagtborg; Integration of Industrial Research and Education, by Linton E. Grinter; Fundamental Research in College and University Laboratories, by Walter Bartky; The Organization, Management and Effectiveness of Institutional Research, by E. R. Weidlein; The Armour Plan for Industrial Research, by Jesse E. Hobson; Trends in Engineering Education in the United States of America, by A. A. Potter; Industrial Research as Viewed by General Electric, by L. A. Hawkins; The Research Program of Universal Oil Products Company, by Gustav Egloff; The Development and Role of Dairying in Wisconsin, by K. G. Weckel; Investigations in Animal Nutrition, by Edwin Bret Hart; Breeding, Feeding, and Management of Dairy Cattle, by E. E. Heizer; Pasture Problems, by L. F. Graber; Research in a State University, by I. B. Baldwin; Agricultural Research Serves the Public Welfare, by Noble Clark; The American Standards Association, by George S. Case; The National Bureau of Standards, by E. C. Crittenden; The Value of Standards to American Industry, by David Levinger; Science, the International Language, by Arthur H. Compton; Newer Developments in Medicinal Research, by E. H. Volwiler; Technology on the International Front, by Maurice Holland; The Management of New Industrial Enterprises on the International

(Continued on page 179)

HELPFUL BULLETINS

(Continued from page 55)

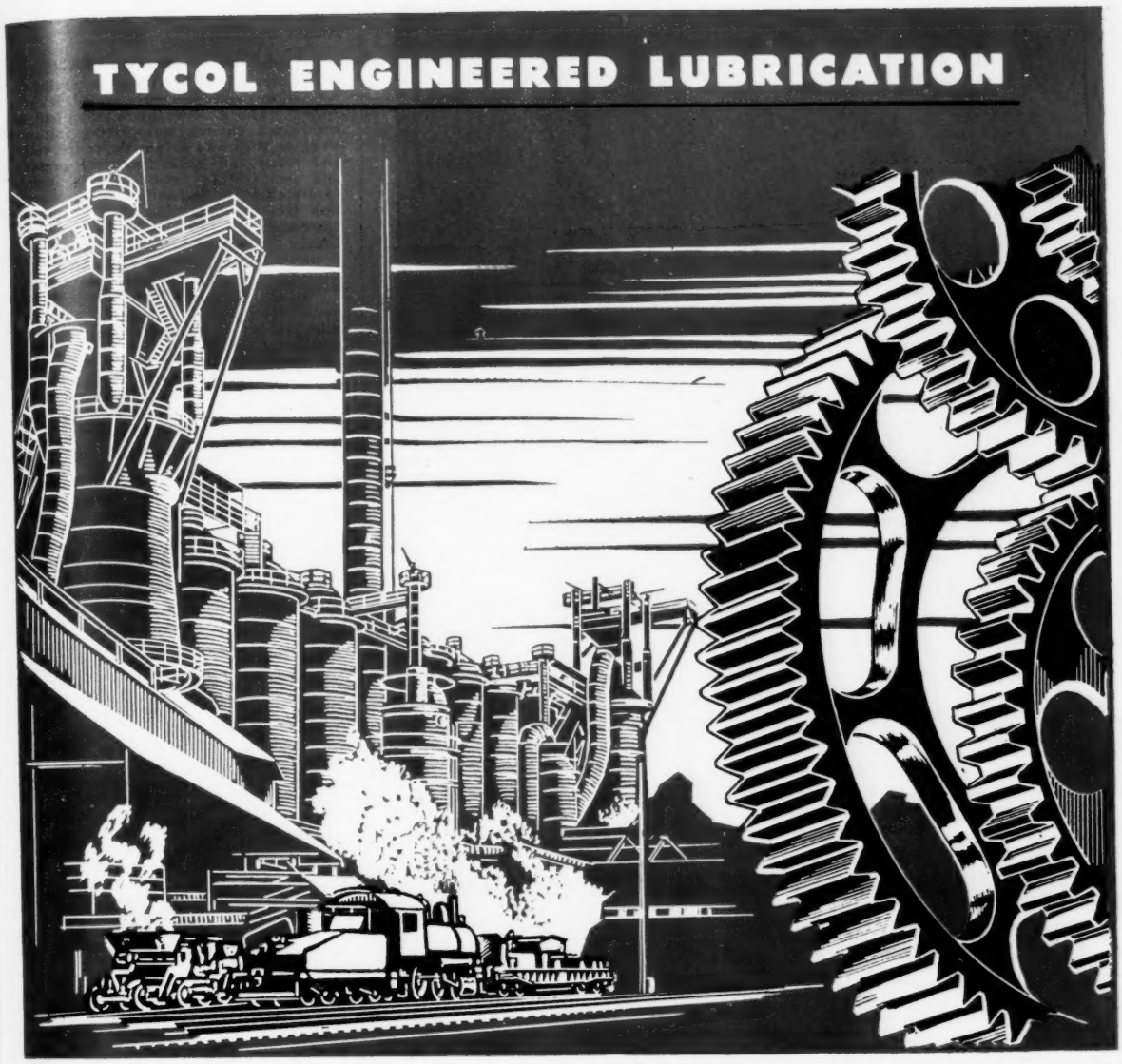
33 Corrosion Bulletin—A bulletin titled, "Prevention of Corrosion in Steam and Condensate Return Lines," was issued recently by this company. The bulletin discusses the reasons for corrosion in these lines and analyzes the type of treatment necessary to combat it. Instructions for use of the treatment—feeding, dosage and control test—are presented and a few words of caution are inserted. E. F. Drew & Co., Inc.

34 Building Maintenance Handbook—These 32 pages of practical information and guidance have just been issued by this company. This illustrated catalog is virtually a handbook which outlines specific maintenance problems and explains how each product may best be used to solve these problems. There are four distinct sections: (1) on products that will preserve and improve floors of all types, (2) on protective and decorative coatings for exteriors and interiors of building and installations, (3) on heat system, water system and metal conditioners, (4) on industrial cleaners and disinfectants. Continental Asbestos & Refining Corp.

PIPING SPECIALTIES

35 Steam Specialties—Bulletin 715 describes representative types of steam traps, separators and boiler trimmings. Three popular types of steam traps have been selected from the company's entire line and these have been quite thoroughly described and illustrated. Brief descriptions of 22 other products are included. Additional data on any of the products may easily be obtained by using a small

TYCOL ENGINEERED LUBRICATION



cuts "down time" . . . increases production

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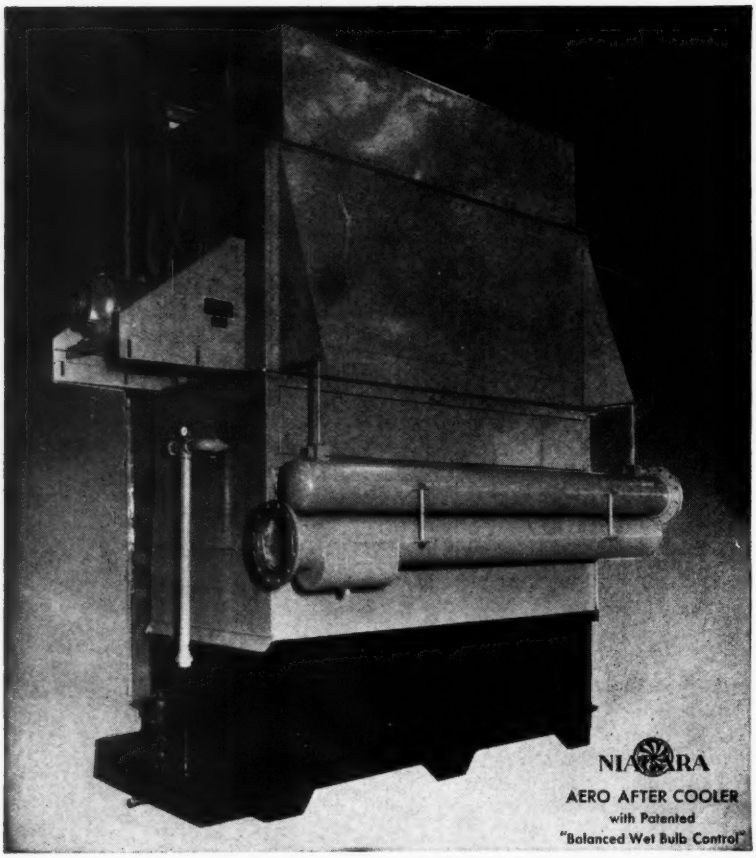
Under all conditions the proved performance of Tycol lubricants more than meets their recommended service.

Rigidly controlled and tested during manufacture, Tycol oils and greases retain their uniformity within each classification — from the first drain to the last. This unvarying high quality accounts for Tycol's wide acceptance among operators interested in cutting down time . . . top efficiency . . . increased production.

Whatever your lubrication need, there's a Tycol oil or grease *scientifically engineered* to afford greater economy . . . longer machine life for every piece, and type of equipment. Let Tide Water Associated help you select the best lubricant for your particular need. Write your nearest Tide Water Associated Office for full details.

LUBRICATION—"ENGINEERED TO FIT THE JOB"



Save expensive "wear out" of air tools

● Water in compressed air lines is more than a nuisance; its cost is thousands of dollars yearly in worn-out tools and equipment, or broken air tools caused by water hammer, abrasion and washed-out lubricants.

Protect your air tools and compressed air processes with drier compressed air . . . using the NIAGARA AERO AFTER COOLER. Based on the evaporative cooling principle, it always keep the air in compressed air lines below the relative surrounding temperature, preventing condensation and, under the least favorable conditions, provides air with one-third to one-half the moisture content of water-cooled air.

Water savings will pay for the installation. Write for

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Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

detachable flap on the bulletin. Wright-Austin Co.

36 **Relief Valves Booklet**—There are 44 pages of engineering and catalog information in this recently issued Bulletin 109RV. The booklet gives complete dimensional, catalog and pricing information on this line of nozzle relief valves and many full page charts of pressure and temperature limits. Tables include saturated steam capacities, vapor correction factors, liquid capacities, superheat correction factors and many others. Crosby Steam Gage & Valve Co.

37 **Air Inlet Valves**—Described by the company as the first bulletin ever to contain complete data on the use of air inlet valves is Bulletin 125. All facts needed to put air inlet valves into use as protection against collapse of thin-walled, gravity flow pipe lines are contained in the booklet. Full page alinement charts make easy many of the calculations. The booklet contains 16 pages. The Simplex Valve & Meter Co.

38 **Steam Jets Bulletin**—A complete description of corrosion-resistant steam jets is given in Bulletin 1804. The bulletin also includes engineering information on application, installation and operation. It describes the special alloys which enable the jets to heat, agitate and circulate corrosive solutions safely. A chart, designed to enable the reader to calculate proper jet size and steam consumption, is presented. The Duriron Co., Inc.

39 **Inner Valves**—Bulletin A-100 pictures and describes the company's Micro-Flute and Micro-Form "PUP" (proportional uniform percentage) inner valves which are described in the bulletin as having equal percentage characteristics. The bulletin is complete with flow curves. Fisher Governor Co.

40 **Expansion Joints**—Bulletin 35-30D, 8 pages, describes the company's internally guided expansion joint for steam, water, oil and other pipe lines. The bulletin gives complete details of construction, dimensions and also lists prices of various sizes from 1¼ in. to 20 in. in single and double joints. American District Steam Co.

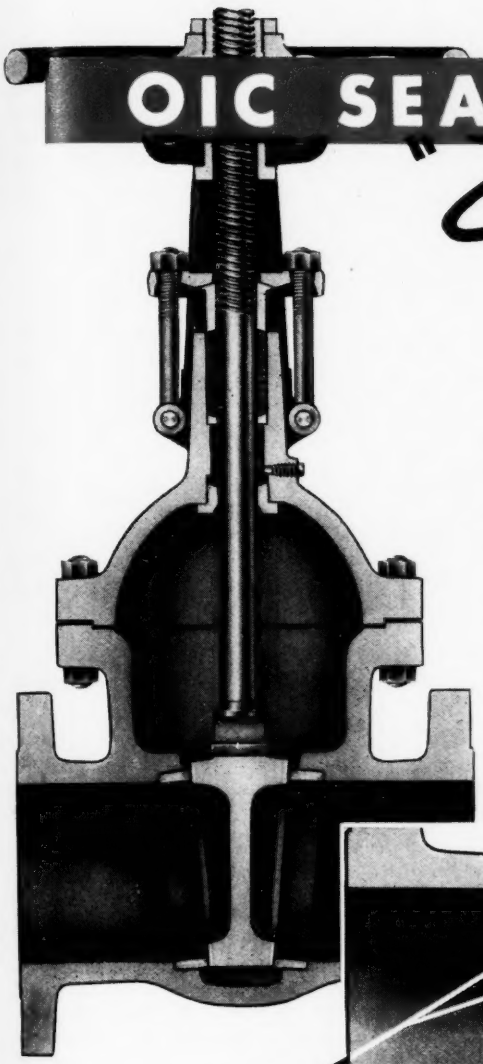
41 **Strainers Bulletin**—Bulletin 224, 4 pages, describes and lists prices and other information on the company's line of strainers. Construction of the strainers is completely outlined and line drawings show types of screens and perforated sheets available. A. W. Cash Valve Mfg. Corp.

42 **Underground Pipe Insulation**—This set of data sheets consists of 13 separate sheets enclosed in a large folder. The folder gives a complete description of the company's underground pipe insulation and method of installing; it tells the composition of the material and describes its outstanding features such as high insulating efficiency and strong monolithic structure. Each of the data sheets deals with a separate phase of the construction of conduits and their insulation. The drawings are well done and easy to follow. Universal Zonolite Insulation Co.

43 **Valve Cross-Reference Chart**—A new 20-page Valve Cross-Reference Chart has just been issued by this company. Containing 20 pages, the booklet presents a complete listing of the company's valve numbers in order, with their descriptions. It is exceptionally well organized and because of this is unusually easy to use. It should be of great value in helping engineers select the right valve for the right job. The Ohio Injector Co.

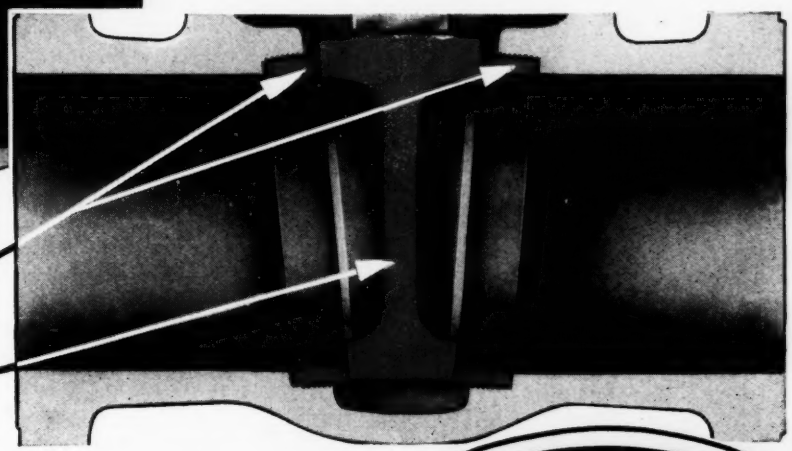
(Continued on page 168)

OIC SEAT RINGS "Sit tight"



TO STOP LEAKS, get your steel gate valves from OIC, designers of a modern and *different* type of seat ring that *"stays put"* even under severest service conditions! In this advanced OIC design, the ring is "backed up" by the solid wall of the valve body, as shown in the diagram. That means that even if the wedge is accidentally jammed hard against it, this ring cannot tilt, shift or loosen. In fact, any force against the OIC seat rings presses them more tightly in place against the body wall!

Another advantage of this OIC design is that it makes possible a thread area *considerably greater* than that found on most conventional seat rings in the same size of valve. All this means positive tightness . . . protection against rough usage . . . less maintenance . . . longer life . . . true economy.



See the new OIC *film*

OIC
SETS THE PACE IN VALVES

Don't miss OIC's new sound slidefilm, "OIC Sets The Pace In Valves!" It's designed to give you the latest, most up-to-date information available on valve manufacturing and valve use. If you would like a private showing in your office—no obligation, of course—just write, giving your name, title and Company, to: **The Ohio Injector Co., Wadsworth, Ohio.**

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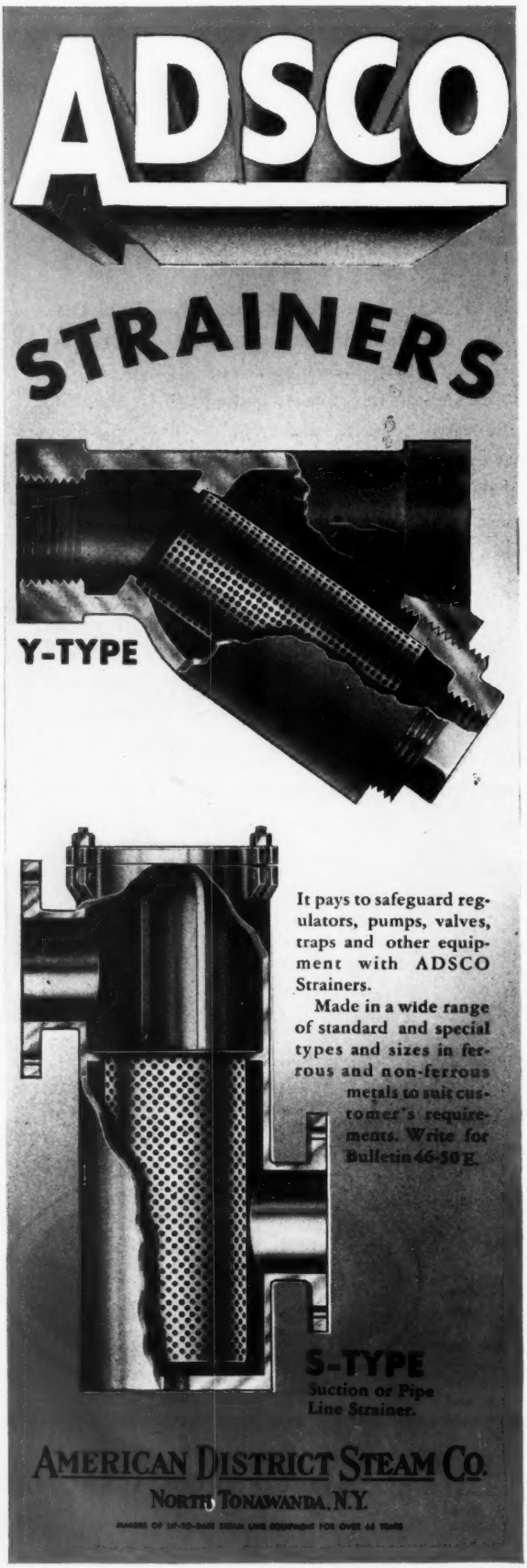
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STRAINERS
Y-TYPE
It pays to safeguard regulators, pumps, valves, traps and other equipment with ADSCO Strainers.
Made in a wide range of standard and special types and sizes in ferrous and non-ferrous metals to suit customer's requirements. Write for Bulletin 46-50 E.
S-TYPE
Suction or Pipe Line Strainer.
AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

ENGINEERS' PREVIEW

SIZE of a dime, new snap-action switch, called Q switch, is designed for incorporation in electrical equipment and industrial mechanisms; has high current- carrying capacity, long-life; is available with normally-open or normally-closed contacts, single or double-throw, single-pole.

★ ★ ★

MULTIPLE endless steel springs operating over 6-in. grooved steel rollers spaced 20 in., comprises the conveying medium of a portable, reversible conveyor. Goods less than 200 lb are moved quickly, around curves to 90 deg., and up inclines to 12 deg., by electric motor.

★ ★ ★

NEW CONVEYOR BELT with rayon plies designed for large power plants, mechanized coal and metal mines, quarries, limestone plants, others needing high tensile strength, is claimed to present easy troughing, fiber resilience; uses conventional idlers and pulleys, adaptable to conventional field splicing, and varying service conditions.

★ ★ ★

SEAMLESS molybdenum tubing is now available in odd sizes from 0.040 to 0.50 in., lengths to 9 ft., other sizes as specials. Can be machined, worked, shaped within reasonable tolerances, welded to iron, nickel, similar materials, stands great heat, not affected by hydrofluoric acid, potassium or sodium hydroxide, only slightly by nitrogen.

★ ★ ★

FOR EFFECTIVE wood preservation, dimensional control Woodtox containing 5 per cent by weight of pentachlorophenol, plus a moisture repellent, in a special light petroleum carrier, is a light-amber liquid weighing 6.8 lb per gal. Exposure dissipates its petroleum odor. Good sealing properties; treated wood is odorless and clean to handle; painting, puttying and filling qualities are improved; renders wood moisture-repellent, preserves against decay, termites, lyctus beetles, etc., also resistant to mold, mildew, prevents warping or shrinking. Recommended for mill-work, floors, prefab house panels, other lumber.

★ ★ ★

WATER-COOLED, flexible, high-powered high-frequency conductor consists of a brass water convoluted inner core with outer braided conductor, flexible insulation extruded over outer braid. Applicable to h-f heating, similar applications.

★ ★ ★

VARIABLE-SPEED control Series MCVA1 for 230-v d-c motors from 230-v a-c power source, can be used on any shunt-wound d-c motor to ½-hp rating. Remote forward reverse and stop push buton controls can be provided, also remote speed control. Dynamic braking of the machine is included.

★ ★ ★

AN EXAMPLE:

This is a diesel engine exhaust manifold outlet fabricated with Tube-Turn welding fittings taken out of regular stock. Replacing castings—eight such outlets to an engine save .71 lbs. per horsepower. Seems little, but multiply this by 1000 and you have 710 pounds of dead weight eliminated.

"It can be done!"

SO MANY piping problems are solved with the use of welding fittings that it pays to see your Tube-Turn Distributor first. He handles *the fitting that becomes part of the pipe.*

Tube-Turn welding fittings—engineered in design, built with closer tolerances than code requirements, available in a wide variety of styles, sizes and materials—often offer just the right answer to what sometimes seems an impossible problem. Welding fittings for example, permit extremely close nesting without flow loss. Tube-Turn welding fittings have uniform wall thickness and full circularity which allows them being cut and used at odd angles. Order one, one-hundred, or a thousand Tube-Turn welding fittings of the same size and part number and they will be dimensionally uniform. They can be and are being used in production line assembly of equipment.

For full information about the more than 4000 types and sizes in the complete line of Tube-Turn welding fittings and flanges—for details about the wide range of special metals and alloys—for the name of your nearest distributor, write to—

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY
District Offices at New York, Washington, D. C., Philadelphia, Pittsburgh, Detroit, Chicago, Houston, San Francisco, Los Angeles.

TUBE-TURN TRADE MARK **tt** *Welding Fittings and Flanges*

LUBRIPLATE

THWARTS CORROSION!

These originally identical shackle pins from a ten ton truck were used in a comparative lubrication test for a period of one year. A well known conventional lubricant was used on the upper pin. Note the pitting from corrosion, also the excessive wear. LUBRIPLATE was used on the lower pin. Its surface remained bright and true as when the test began, proof that LUBRIPLATE is different . . . better.

LUBRIPLATE

Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE

Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE

Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

LUBRIPLATE

FISKE BROTHERS REFINING CO.

NEWARK 5, N. J. TOLEDO 3, OHIO

DEALERS FROM COAST TO COAST

CONSULT YOUR CLASSIFIED TELEPHONE BOOK

HELPFUL BULLETINS

(Continued from page 164)

44 Welded Floats Bulletin—Bulletin 746, 8-pages, covers the manufacturer's line of spherical, elliptical and cylindrical floats for applications in the refinery, dairy, cannery, chemical and steam specialty fields. Advantages of construction are described in detail and guides for selection of the proper shape and the proper connections are given. Another useful section is the tabular material which presents list prices, weights, buoyancy and collapsing strength of various floats. W. H. Nicholson & Co.

MISCELLANEOUS

45 Hot Water Storage Heaters—Catalog 17, 20 pages in a separate paper cover, describes the company's line of hot water storage heaters and preheaters. Descriptions of the equipment cover standard construction details. Tables present information on capacities and weights and clearance dimensions. Conversion tables for help in determining the heating capacity of various sections of the heaters also are given. Still more information is included in the sections titled: Hot Water Consumption for Various Types of Buildings, Steam Required to Heat Water. The Patterson-Kelley Co., Inc.

46 Gas-Fired Unit Heaters—This eight-page bulletin—AIA File No. 30-C-43—describes the company's gas-fired unit heaters. Complete details of construction are given as are complete tables of roughing-in dimensions. The various types of heaters are described separately with illustrations, tables of capacities, dimensioned drawings and tables of dimensions. Information on selection of sizes and "How to Order," is given. Surface Combustion Corp.

47 Steam Engines—Bulletins 307 is an 8-page publication which covers the company's horizontal types of steam engines. The folder tells of the advantages of using a steam engine under many conditions and also presents sectional drawings, photographs and tables of engineering data. Construction details of many parts such as valves, connecting rods, crankshafts, etc. are discussed and pictured. Troy Engine & Machine Co.

48 Driving Tube Expanders—The problem of driving tube expanders at right angles to the tube or in any other hard-to-get-at place is simplified by the right angle gear drive described and illustrated in this recently-issued catalog. The tool is made in several sizes and all dimensions of the tool are presented in tabular form. A drawing of the tool in use also is given. Airetool Manufacturing Co.

49 Tanks for Industry—The sixteen pages in this recently-issued catalog describe the tanks manufactured by this company. The processes followed in making the tanks are thoroughly explored and typical products turned out are illustrated. An exceedingly useful section of the booklet consists of two full-page tables which show corrosion-resistant values of various metals (used in the tanks) when they come in contact with many listed chemicals. John Nooter Boiler Works Co.

50 Tube Cleaners Bulletin—Bulletin 38 covers a line of tube cleaners for small diameter tubes. Various types of heads are illustrated and clearly described and a large table presents information on expanding brush head cleaner sizes. Cleaners for heavily scaled and lightly scaled tubes are described. A full page of tables give miscellaneous information. Airetool Mfg. Co.

Can the Capacity of a Reciprocating Pump be increased by the introduction of a particular type of water valve?

SUPPOSE we take a typical pump problem and see:

What is the capacity of a single acting pump?

PROCEDURE

(1) Compute the volume "V" displaced by the plunger

$$V = \frac{\pi}{4} D^2 S$$

in which

D=diameter of water plunger (inches)

S=stroke (inches)

π=3.14

(2) Multiplying "V" by 0.00433 (number of gallons per cubic inch) gives us gallons, and if we also multiply by the number of strokes per minute "N" we will get gallons per minute. Thus

$$\text{Gallons/minute} = 0.00433(N)\frac{\pi}{4} D^2 S$$

Example: What is the capacity of a 6x4 x 6 pump making 10 strokes per minute?

$$\text{gal/min} = 0.00433(10)\ \frac{\pi}{4}\ (4)^2\ (6) = 3.26$$

We see that the capacity of this pump is 3.26 gallons per minute—THAT'S ALL.

The above calculation shows that the CAPACITY of a reciprocating pump *cannot* be increased through change of water valves. It also suggests that the VOLUME could be increased per hour through more strokes. But Webster reminds us that CAPACITY AND VOLUME have different meanings.

* Combination Pump Valve Type B Assemblies assure maximum capacity through the water end of reciprocating pumps.

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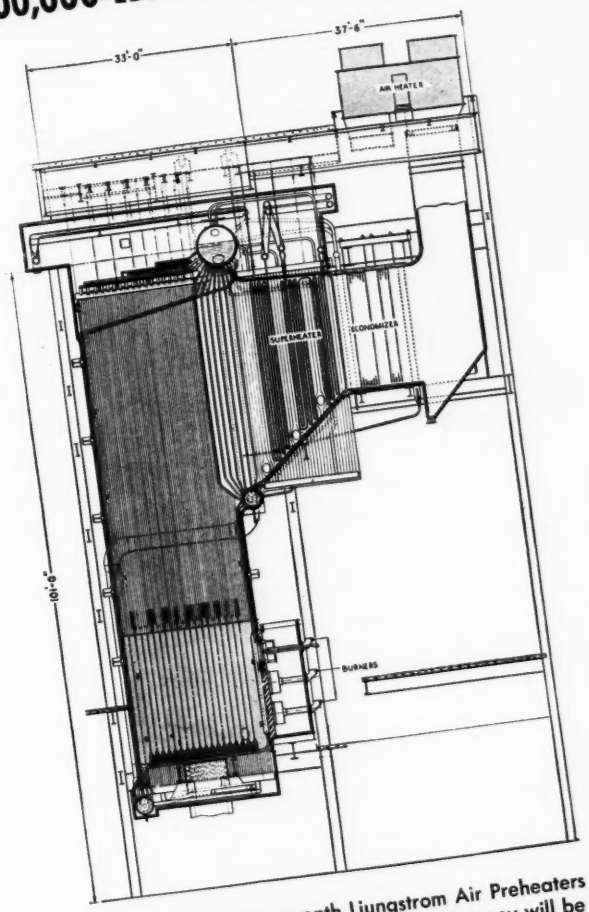
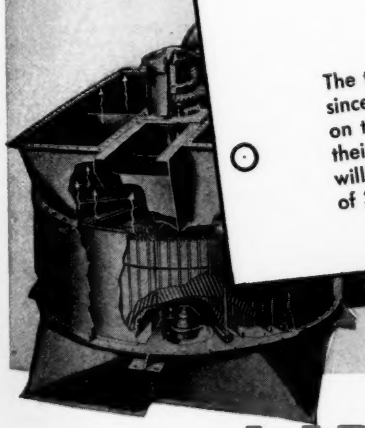
ENGINEERING PROGRESS REPORT #14

LJUNGSTROM AIR PREHEATER

NEW 1,000,000-LB. STEAM GENERATING UNIT



The twenty-sixth and twenty-seventh Ljungstrom Air Preheaters ordered since 1927 by Public Service Electric and Gas Company will be installed on the new 1,000,000 pounds per hour Babcock and Wilcox boiler in their Essex Generating Station at Newark, N. J. These two Ljungstroms will supply preheated air at 730 F. with full-load exit-gas temperature of 347 F.



THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS

51 **Steam Generators**—Catalog almost completely devoted to cross-sectional drawings with accompanying listing of principal data of typical installations in rubber companies, steel works, sugar refineries, muncipal plants, etc. Details of furnace water wall construction on inside back cover; 16 pages. Henry Vogt Machine Co., Inc.

52 **Double-Pass Boilers**—Bulletin RM-1 (6th edition); illustrates and describes this line of riveted or welded double-pass steel firebox boilers. Three full pages of dimensions, ratings and other details including dimensioned line diagrams; 8 pages. The Brownell Co.

53 **Boilers, Burners, Accessories**—Bulletin GC-10; condensed catalog of regular products for stationary power plants. Each class of equipment summarized and illustrated. Well illustrated with line drawings and photographs. Illustrations accompanied by brief descriptions; 12 pages. Combustion Engineering Co., Inc.

54 **Standardized Boilers**—Bulletin 746; 4 page bulletin presenting construction and operation information and ordering specifications for this company's Type M boilers. Bulletin illustrated, presents table of measurement and data. Springfield Boiler Co.

55 **Steam Generators**—Presents reasons for high efficiency; shows brief case histories of plants. Results of tests by independent authorities and "Facts You Should Know About Steam Generating Units." Ratings, dimensions and other data presented. Springfield Boiler Co.

56 **Steam Generator**—Bulletin 119; company's Type S steam generator described and features of construction are pointed out. Folder well illustrated and dimensioned drawing and table of dimensions and sizes are given. Union Iron Works.

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High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDROID

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STONEGA

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CRITERION COAL

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CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO

High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Vgn. Ry.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

ANTHRACITE — Hazle Brook Premium . . . Raven Run

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PRIME MOVERS

57 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. The Terry Steam Turbine Co.

58 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

59 **Turbines, Pumps, Products**—This 24-page catalog covers the company's complete line of products from steam turbines to flexible couplings. Every product is discussed from the design and operation angles and the discussion is heightened in interest by the inclusion of many excellent photographs. Other products discussed are helical gears, centrifugal pumps, multistage pumps, screw pumps, blowers, compressors and speed reducers. De Laval Steam Turbine Co.

60 **Turbine Cleaning Manual**—This 20-page bulletin covers the step-by-step solvent and manual cleaning of turbines from the inspection and preliminary cleaning to draining and final inspection. The cleaning of bearings and governor, installation of filter unit, circulation of cleaning solvent, and displacemet of cleaning oil with new lubricating oil are steps which are covered briefly but clearly. Shell Oil Company, Inc.

61 **Steam Engines**—Bulletin No. 306; Engineering data; tabular material, descriptions; 8 pages. Troy Engine & Machine Co.

62 **Generating Sets**—Bulletin No. 108; General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

63 **Stationary Diesel Engines**—Dependability, adaptability of Diesel power described and applications pointed out. Its economical and simple design is stressed. Advantages of company's equipment brought out; exceptionally well illustrated; 24 pages. Enterprise Engine and Foundry Co.

ELECTRICAL

64 **Oil Circuit Breakers**—Bulletin 71B-6421 describes Unitop oil circuit breaker; ratings from 15 to 46 kv, 500,000 to 1,500,000 kva interrupting capacity. Well illustrated. Allis-Chalmers Mfg. Co.

65 **Generating, Substation Equipment**—Bulletin 25B6150 titled "More Power to U.S.A." 32 pages; sketches coverage of the company's equipment from hydro and steam turbines to switchgear and circuit breakers. Unusually well illustrated. Allis-Chalmers Mfg. Co.

AUXILIARIES, ACCESSORIES

66 **Strainers and Separators**—Bulletin 46-50; describes complete line of company's strainers and separators. Dimensioned drawings and photographs; tables of sizes and complete description of applications, operation and design; 16 pages. American District Steam Co.

67 **Atomizing Deaerators**—Bulletin 4160; 3 color drawing illustrates description of principle of operation. Advantages of deaerators are described and illustrated; marine deaerators also covered; 20 pages. Cochrane Corp.

UNIFORM WALL THICKNESS

Ladish Seamless Welding Fittings agree with pipe sizes in both inside and outside diameters, thus OD alignment automatically insures ID alignment. This prevents harmful offsets that cause turbulence and pressure loss.

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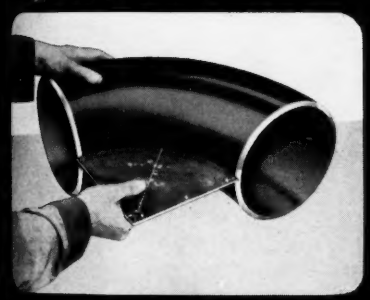
Uniformly smooth inner surfaces, free from buckling and irregularities, reduce frictional resistance and minimize pressure drop throughout the entire piping system.



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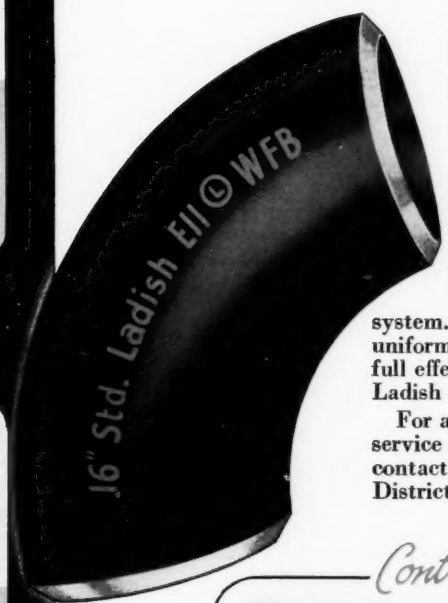
Being true arcs of circles, Ladish Ells and Return Bends reduce turbulence and pressure loss because changes in flow direction are uniform and gradual at all points around the fitting.

CIRCULARITY

True circularity and full diameter safeguard against pressure loss and undercutting caused by flattened or distorted surfaces.

For MAXIMUM Flow Efficiency

INSTALL LADISH SEAMLESS WELDING FITTINGS



Modern piping practice . . . with its steadily mounting pressures and velocities . . . demands fittings which have been carefully designed to reduce turbulence, frictional resistance and pressure losses to a minimum.

Ladish Seamless Welding Fittings are designed and produced under the most rigid controls to insure not only the strength and toughness needed to withstand these stresses—but to provide features that maintain smooth, undistorted flow throughout the piping system. The panel at left explains how the uniform walls . . . smooth inner surfaces . . . full effective radii . . . and true circularity of Ladish Fittings promote flow efficiency.

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68 **Condensate Return System**—Description of operation and possible savings accompanied by line diagram and description of how "Jet-Loop" works; typical installation pictured and described. Drawings and text show proven results from experience of users. 2 page spread of drawings and table of dimensions; 16 pages. Cochrane Corp.

69 **Low Pressure Evaporators**—Description of L. P. evaporators; types of evaporator plants, listing of advantages of L. P. submerged tube evaporators. Line diagrams illustrate principles brought out in descriptions. Typical installations are considered and analyzed; 12 pages. Condenser Service and Engineering Co., Inc.

70 **Power and Industrial Equipment**—Bulletin Q-12; describes and illustrates company's equipment for power and industrial use—steam turbines, motors, generators, feedwater heaters, turbochargers, steam jet ejectors, centrifugal blowers. Exceptionally well illustrated; 20 pages. Elliott Co.

71 **Heat Exchanger**—This new bulletin describes the company's Twin G-Fin Section; Bulletin 1614; section characterized as universal heat exchanger. Bulletin tabulates 21 features and corresponding advantages, describes design and construction. Installation views shown, field reports included; 16 pages. The Griscom-Russell Co.

72 **Evaporators**—Bulletin 364 describes, illustrates evaporators for various capacities and pressures; contains sections of special interest to plant engineers and executives; includes explanation of functions of evaporators, benefits obtained by their use; different types of evaporating systems and their association with plant balance. 26 pages. The Griscom-Russell Co.

73 **Soot Blowers**—Bulletin F45; soot blowers in general are described. Description and operation of units, materials and specifications and other pertinent information is presented; tables of steam consumption, boiler efficiency, fuel saving chart; boiler cross-sections with blower locations indicated thereon and installation drawings and data are included; 10 pages. Marion Machine, Foundry & Supply Co.

74 **Water Heater Capacity Ratings**—14 tables are included in this ratings booklet showing capacity ratings per hour for temperature rises of from 20 deg (50 to 70 deg) up to and including ratings for a 150 F temperature rise (50 to 200 F). Table No. 15 presents the rate of flow of steam through pipes with steam from an initial gage pressure of one pound up to 150 psi. Marion Machine, Foundry and Supply Co.

76 **Coal Weighing Scales**—Description; outstanding features, specifications, line drawings, photos; 4 pages. Beaumont Birch Co.

77 **Rack and Pinion Gates for Coal and Ashes** — Ball-bearing, dust-tight features; photos, specifications, drawings, tables of dimensions; 4 pages. Beaumont Birch Co.

78 **Steam Specialties**—Collection of folders; steam trap, air trap, reducing valves, classes E, B and H pump governors, automatic boiler feedwater controller; parts and unit list prices; descriptions; illustrations; tables of capacities. The C. E. Squires Co.

79 **Deaeration**—Data book; No. N-15 gives reasons for and principles of deaeration; cold water deaeration; tabular drawing and chart material presented; well illustrated; 20 pages. Elliott Co.

80 **How to Choose a Steam Trap**—Trap selection, trap rating, trap capacity factors, individual trapping, determining lift; traps for unit heaters, pipe coils, fan system heating surfaces, steam jacketed kettles, autoclaves, laundry equipment, paper makers, etc.; installation, operation, maintenance, instructions; specifications and capacities; corrosive service; 42 pages. The V. D. Anderson Co.

WATER TREATMENT

81 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar, tables and charts; 16 pages. National Aluminate Corp.

82 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

83 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

84 **Water Conditioning Service**—"The Fundamentals of Betz Water Conditioning Service" illustrates and describes how this company extends a supervisory service for boiler water conditioning. Booklet shows complete operation of these 6 steps; 16 pages. W. H. & L. D. Betz.

85 **Water Softeners**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

86 **Softener Handbook**—Manual, semi- and full-automatic zeolite water softeners are covered in Bulletin 315. Water softener plant is discussed in the first section and operating cycles and plant supervision is next considered. The third section is "Selecting Manual or Automatic Equipment"; this is accompanied by a table of comparison data. Graver Tank & Mfg. Co., Inc.

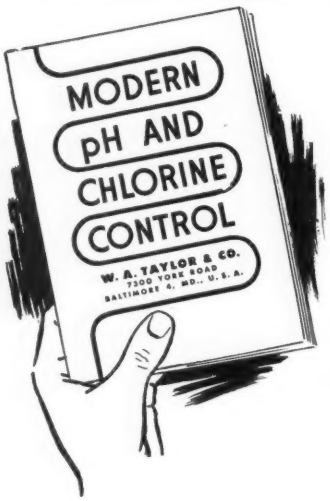
87 **Sludge Reactivator**—Illustrated booklet, 8 pages, fully explains the principle of upward sludge filtration and describes its adaptability to industrial and municipal water supplies. Charts, flow diagrams and cut-away drawings show clearly how equipment softens and clarifies raw water, materially reduces reaction time and provides, in many cases, a water that is suitable for process work without further treatment. Graver Tank & Mfg. Co., Inc.

88 **Hot Process Water Treatment**—Form 326 is a case study bulletin; covers results of an installation of the company's hot process equipment at Kankakee Ordnance Plant. System was designed to provide 60,000 gph of properly conditioned water, free from hardness, scale forming minerals and corrosive gases. Graver Tank & Mfg. Co., Inc.

89 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Products, Inc.

90 **Industrial Water Treatment**—Micro-biological Control of and Through Industrial Waters; spot summaries of improvement of process efficiency and product quality of proper sterilzation. Wallace and Tiernan Products, Inc.

91 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important considerations in chemical treatment of cooling water circuits. Wallace & Tiernan Products, Inc.



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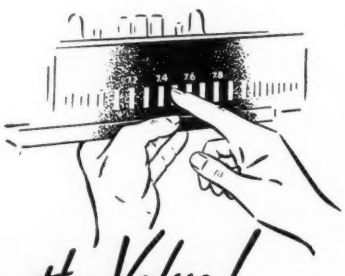

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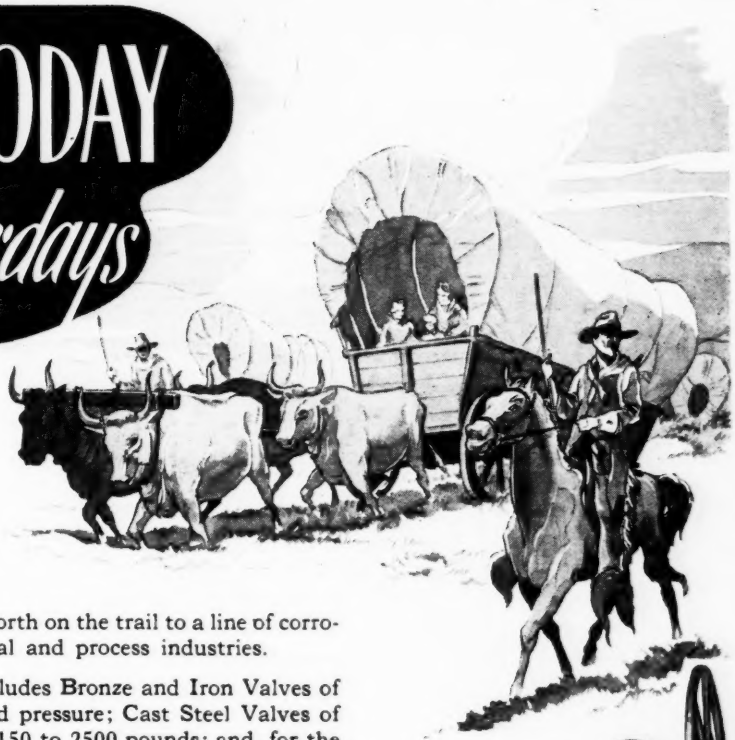

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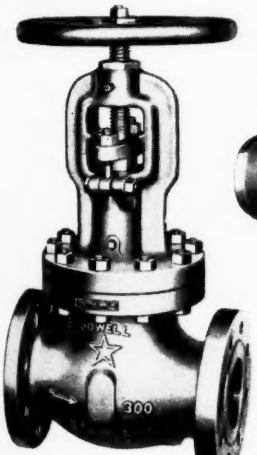

Fig. 3031 S. S.—Class 300-pound Stainless Steel Globe Valve, made to ASA dimensions and especially adapted for high pressure, high temperature boiler feed water treatment solutions. Has flanged ends, bolted flanged bonnet and outside screw rising stem. Also available with socket welding or butt welding ends.

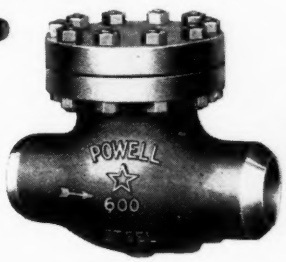

Fig. 6065 W. E.—Class 600-pound Cast Steel Horizontal Lift Check Valve with welding ends and bolted flanged cap.

Fig. 1323—Class 1500-pound, 8", Cast Steel Gate Valve with welding ends, welded bonnet and special by-pass. Top mounted electric motor operator provides quick, positive opening and closing by remote control.

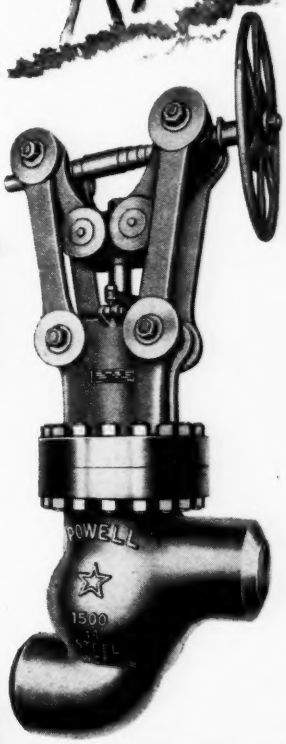

Fig. 1393—Class 1500-pound, 14", Cast Steel Non-Return Angle Valve with welding ends and bolted flanged bonnet. Toggle operated for easy opening and closing of valve.

The Wm. Powell Co., Cincinnati 22, Ohio

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POWELL VALVES

92 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Products, Inc.

93 **Clarifying and Softening Water**—Eight-page catalog "Reactivator for Clarifying and Softening Water by Upward Sludge Filtration." First part of the booklet tells how the reactivator works and how the sludge blanket is kept in control so as not to flow out with the clarified water. Line diagrams illustrate the principle of operation. Graver Tank & Mfg. Co., Inc.

94 **Feed Water Treatment** — This four-page folder tells how the company's engineering applied to boiler feed water problems can result in savings. It tells of the different procedures and presents diagrams of equipment arrangement. Typical installations in dairy, cosmetic, aircraft, laundry, and other plants are pictured. Illinois Water Treatment Co.

95 **Chemical Feeding and Proportioning**—Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

96 **Automatic Proportioning**—Bulletin 1200, 28 pages. Handy reference book containing wealth of information on automatic flow responsive equipment and methods in continuous process operation. Photos of equipment and installation are supplemented by many flow diagrams and detail drawings. Complicated subject made exceptionally clear and understandable by careful arrangement and two-color diagrams. Proportioneers, Inc.

97 **Chemical Proportioning Equipment** — Bulletin 1714 covers chemical proportioning equipment for sea-going service. Two units—for high or low pressure—are described fully. Tabular material assists in the description. Proportioneers, Inc.

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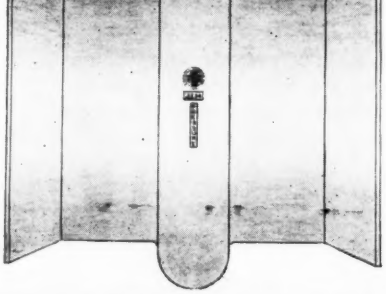

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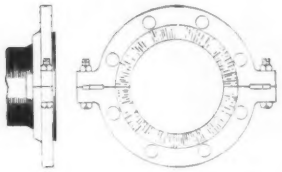

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These are designed to simplify installation and assure a positive seal. They are furnished in steel or cast iron, depending upon the size. Bolt holes are easily aligned by turning flange **only.** The magnitude of the forces making the seal is in direct proportion to the stress applied to the bolts when tightening them.

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98 **Water Conditioning Instruction Booklet**—Bulletin 28X6385 was written especially for guidance of power plant operators. It touches upon importance of feedwater control, care of testing equipment, obtaining samples, test procedures. Handy reference tables given as aid to reporting results. Allis-Chalmers Mfg. Co.

99 **Complete Water Conditioning Service** — This four-page bulletin describes this company's complete water conditioning service—analysis, design, fabrication, installation and maintenance of water treating equipment. Typical installations are pictured and brief sketches of the men behind the service are given. Graver Tank & Mfg. Co., Inc.

COATINGS, TREATMENT

100 **Protective Coatings**—4-page folder 844.246 describes Bitumastic Hi-Heat Gray, a specialized industrial protective coating which is said to resist corrosion and temperature up to 1200 F. The folder is in 2 colors and contains several photographs of equipment on which Bitumastic has been applied. It also gives a list of uses for the material and a chart giving its characteristics. Wailes Dove-Hermiston Corp.

101 **Fuel Oil Treatment**—A 4-page bulletin, telling about the company's treatment for fuel oil called "No Sludge." Advantages of using the treatment such as stepping up efficiency and reducing operating casts are explained. A list of dosages and applications is also given. A free test offer of the treatment is explained on the first page of the bulletin. Dominion Chemical Co., Inc.

102 **Flu Cleaner**—The company's soot and fire scale removing compound is described in this six-page folder. Results obtained from the use of this compound are described in the first part of the folder and then a list of the things which the company guarantees the material will accomplish are listed. Tables of dosage are presented and another table shows losses due to soot and fire scale. Dominion Chemical Co., Inc.

103 **Boiler Rust Treatment**—This four-page bulletin describes the company's "Rustoff" chemical which is said to "build resistance to rust and scale corroded and congested pipes." The bulletin tells how the treatment works and what results may be expected from its use . A brief description of the company's service department is included. Dominion Chemical Co., Inc.

104 **Fuel Oil Treatment** — Several bulletins have recently been announced by this company describing completely the application and effect of its fuel oil treatment compound and Diesel engine solvents. Wilcolene Mfg. Co.

HEATING, COOLING

105 **Cooling, Heating, Air Conditioning** — Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data, numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc. Niagara Blower Co.

INSULATION

107 **Industrial Insulations**—Block, blanket insulations; pipe covering; new pressure coverings; insulating cement; felt; Koldboard; fill insulation; diatomaceous earth products; uses, specifications, applications, preparation; charts; photos; list prices; 26 pages. Baldwin-Hill Co.

108 **Insulating Cement**—East of application, efficiency; ease of maintenance application recommendations; heat loss calculations; 4 pages. Baldwin-Hill Co.

STOKERS

109 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 tables. American Engineering Co.

110 **Water-Cooled Stoker**—Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

111 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

112 **Pneumatic Spreader Stoker**—Three-fold booklet on the inner pages of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

113 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

114 **Coal Reference Bulletin**—Bulletin 8, Underfeed Stoker Firing, Bulletin covers

factors involved in selection of multiple retort stokers, principles, design data and drawings of typical installations; 6 pages. Fairmont Coal Bureau.

115 **Stoker Firing Operation**—Single Retort Underfeed Stoker Firing is the subject of Bulletin Number 9 issued by this Bureau. It is a complete analysis of the advantages of the single retort stoker in the smaller plants. Types of this stoker are described and principles of operation are outlined. Fairmont Coal Bureau.

OIL, GAS BURNERS

116 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control, drawings; 4 pages. Peabody Engineering Corp.

117 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

118 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross-sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

OIL, LUBRICATION

119 **Lubrication Recommendations** — Special oils for Diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

120 **Cutting Fluids**—Facts about cutting fluids; machine tool operations; fundamentals of cutting; how to apply; metallic cutting tools; tabular material; show practices; 50 pages. Standard Oil Company of California.

121 **Diesel Operation**—Relation of fuels and lubricants in the operating efficiency in the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

122 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

123 **Lubricants Service Handbook**—28 pages in this booklet on lubricants and their application. The development of the lubrieant, its features and advantages and the manner in which it meets various operating conditions take up the fore part of the booklet. "Recommendations" section where the manufacturer tells just what grease or oil should be used according to speeds, temperatures, pressures and general service conditions is given. Fiske Brothers Refining Co.

124 **Oil Products for Industry**—Cutting oil, processing oils, general lubricants, refrigeration oils, Diesel oils, solvents, greases and waxes are among the petroleum products for industry which are described in this four-page folder. The various grades of each oil are analyzed and the reasons why they are fitted to each particular job are given. Sun Oil Co.

125 **Lubricania**—The hundreds of specialized lubricants in use today are identified by certain commonly used tests and terms which describe their physical characteristics. In this dictionary of terms, tests and values, the company has highlighted the most important of these. Tide Water Associated Oil Co.

POWER TRANSMISSION

126 **Speed Reduction, Increase Gear**—Bulletin S-130; description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Terry Steam Turbine Co.

127 **V-Belt Drive Guide**—Bulletin B6051F; guide to company's complete line of V-belt drives. Contents include types and sizes. V-belt prices, how to figure drives, belt selector charts and tables and similar engineering information. Well illustrated; 12 pages. Allis-Chalmers Mfg. Co.

128 **Chains and Sprockets**—Bulletin D-1; 2 color digest catalog, profusely illustrated, gives pertinent information on drive and conveying chains and sprockets, finished steel roller chains and sprockets, silent chains and sprockets, flexible couplings. Tables of numbers and pitches are given as are full page tables of list prices, dimensions and weights; 16 pages. Union Chain & Mfg. Co.

129 **Flexible Couplings**—Bulletin 57; 2 pages of drawings and tables of ratings for companys flexible couplings. Installations are shown and features of the various types are discussed; 20 pages. John Waldron Corp.

VALVES

130 **Regulating Valves**—Bulletin 1-A; valve data book, description, dimensions and lists of parts; typical installations, rated capacities; prices; 52 pages. Atlas Valve Co.

131 **Pressure Regulator**—Bulletin 1-B; description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

132 **Pressure Reducing Valves**—Bulletin 1-C; sectional drawings, list prices, dimensions and weights; operation and adjustment; capacities for steam and air; 12 pages. Atlas Valve Co.

133 **General Service Valves**—Bulletin E-150; valves for blow-off; fire protection, soot blower lines, acids, process etc.; descriptions; exploded views; features; dimensions, weights and list price tables; parts and parts lists; 14 pages. Everlasting Valve Co.

134 **Valves**—Bulletin E-100; for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

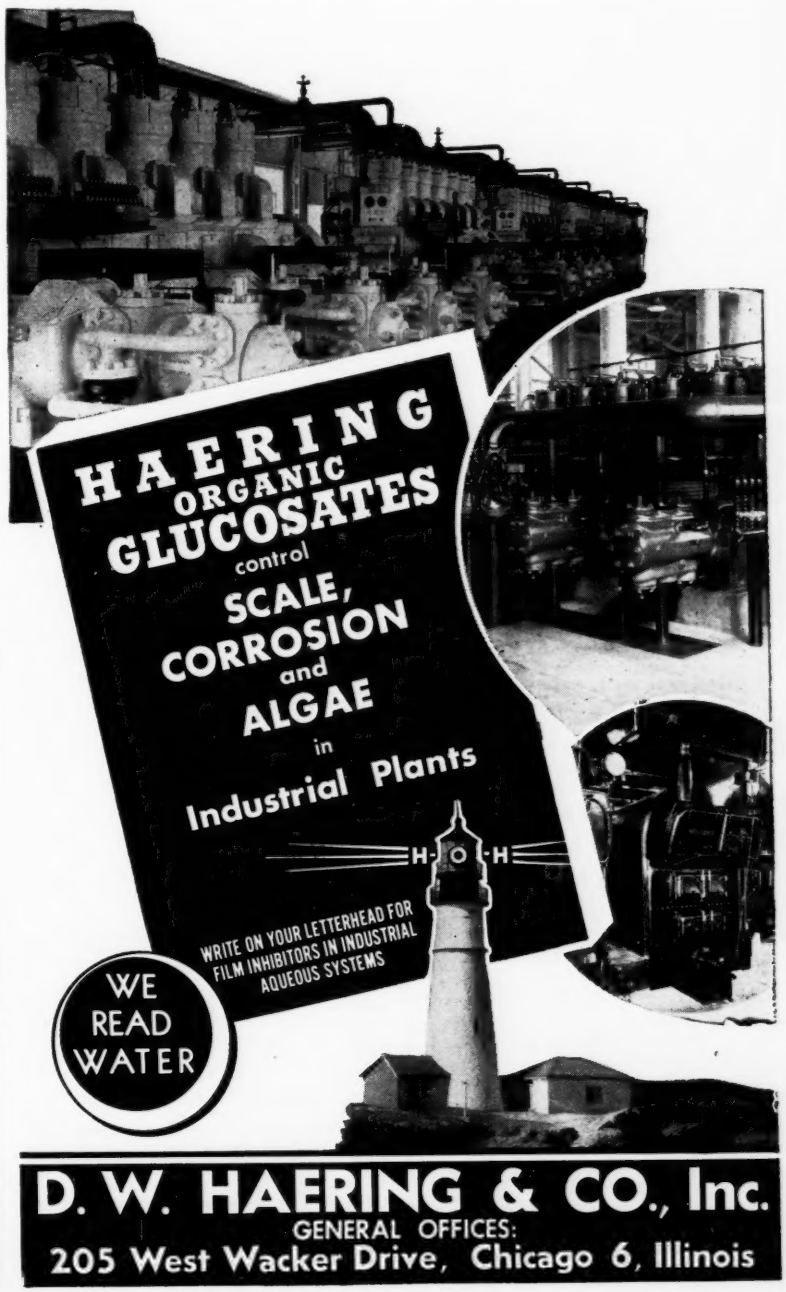
135 **Multiport Relief Valve**—Bulletin 4150; complete description of valves and operating characteristics, photographs of typical installations. Engineering data includes sizing information tables, nomenclature, installation and operation, list of prices of accessories, dimensioned drawings and tables of dimensions; 28 pages. Cochrane Corp.

136 **Steel Valves**—Bulletin 102; 4 page bulletin describing company's "Evrtyte" valves. Cross-sectional illustrations and tables of seat orifice sizes, prices and dimensions are given; listing of features, description of the operation of the unit and parts and prices for assemblies. Strong, Carlisle & Hammond Co.

137 **Diaphragm Motor Valves**—24 pages. Covers Why and How of unit's design. Materials specifications given as are two pages of engineering information and charts. Kieley & Mueller Co.

MAINTENANCE

138 **71 Maintenance Jobs**—This guide tells how better to perform commonly occurring power plant maintenance and cleaning opera-



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tions. Illustrated manual gives specific material and method recommendations for handling cleaning, degreasing, descaling, derusting, paint stripping, etc. Booklet is completely indexed and reference is made by colored type strips on edge of the pages; 22 pages. Oakite Products, Inc.

139 **Protecting Metal**—High heat resistant coatings for protecting metal surfaces in power and processing equipment are covered in 4 page bulletin. Brief description of properties of coatings are given. The Dampney Co. of America.

140 **Condenser Tube Inserts**—Description of Flowrites; illustrated, accompanied by report of tests on Flowrites made by M.I.T. Tables and charts of test results are presented; description of how to install inserts given; 8 pages. Condenser Service & Engineering Co., Inc.

CONTROLS, METERS

141 **Damper Regulators**—Bulletin 4-A; for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adjustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

142 **Thermostats and Relays**—Bulletin T, a 12-pg. catalog presents significant information on this company's mercurial thermostats and adjustable thermoregulators. Also included is complete data on relays, designed as companion instruments to the above mentioned. Complete descriptions of the instruments are included and the bulletin is well illustrated. Precision Thermometer & Instrument Co.

143 **Recording Flow Meter**—Bulletin 349; what it does, features, chart of rated capacity; construction and operation; installation drawings, tables of capacity; photos; 8 pages. Builders-Providence, Inc.

144 **Propeller-Type Meter**—Bulletin 350A; for main-line metering; applications, description, installation, materials of construction; features; table of capacity, shipping weights; specifications, drawings; 4 pages. Builders-Providence, Inc.

145 **Centralized Combustion Control**—Bulletin 43-605; applications to various types fuels and burning equipment; controller, measuring elements, pilot device, power unit, etc.; 24 pages. The Hays Corp.

146 **Combustion Meters** — Bulletin 44-550; reasons why it is accurate, dependable, simple, rugged, easy to install, easy to maintain, speedy, easy to understand; well illustrated by explanatory diagrams; 16 pages. The Hays Corp.

147 **Feedwater Textbook**—"Mechanical Feedwater Regulation for Boilers" by Prof. E. P. Culver; principles of feedwater regulation; mechanical equipment available; differential pressure control; feed pump control; illustrations, diagrams, charts; 36 pages. Northern Equipment Co.

148 **Engineering Monographs**—Series of eight on automatic combustion control; 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Traveling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

149 **Draft Gages**—Bulletin 46-667; gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; descriptions of equipment; differential units, Bourdon tube units, pointer gages, etc; 20 pages. The Hays Corp.

150 **Draft**—Bulletin 46-472; what draft is; where it is found; how it is measured; what the draft gage tells, where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

151 **Flue Gas Analyzer**—Bulletin 45-668; principle of operation; construction features; technique; models and prices; Burrettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

152 **Indicating, Control Systems**—What they are, what they can do; Bulletin 14B6641. Description of how transmitter, receiver and indicator of systems are constructed, how they work, their advantages and specifications. Illustrated with photographs, diagrams, charts; 12 pages. Allis-Chalmers Mfg. Co.

153 **Water Gages**—Condensed catalog, Bulletin E, of company's complete line of water gages. Each model illustrated and accompanying table gives sizing information; 8 pages. Ernst Water Column & Gage Co.

154 **Stainless Steel Bellows**—Bulletin SSB-46; contains diagrammatic cross-section views and up-to-date information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors for flow control, vapor and steam traps, thermostatic instruments, etc. Completely illustrated; 12 pages. Chicago Metal Hose Corp.

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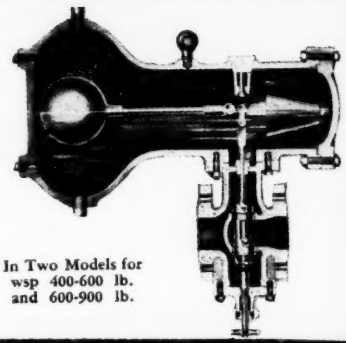

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155 Pitot Equipment—Three section Bulletin 50; gives complete details of the use of Pitot tubes and rods, instructions in the use of the company's portable Pitot recorder, together with theory, formulae, notations and curves. Completely indexed; 20 pages. Simplex Valve & Meter Co.

156 Manometers—Bulletin 200; describes completely this line of fixed and portable manometers for use in water surveys and similar flow rate measurement, valuable engineering data also included. Illustrations include line drawings and photographs; 8 pages. Simplex Valve & Meter Co.

157 Instruments, Controls for Process—Bulletin 17; process controllers, control components, measuring components and instrument combinations briefly described and illustrated. Application data such as sizes, pressure standards and ranges are listed; 8 pages. Bailey Meter Co.

158 Temperature Regulators—Bulletin 7-A; six types; descriptions; list prices, tabular material, photos; list of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

159 Draft, Excess Air and CO_2—Bulletin 39-341; discussion of the relation of these elements to the installation and servicing of bituminous and anthracite stokers by Arnold Soller; 12 pages. The Hays Corp.

160 Liquid Level Controllers—Bulletin A-100 is a four-page catalog describing this company's Types G and D liquid level regulators. Excellent cross-sectional views of the units are presented and their operational and constructional features are described. Dimensions, capacities and shipping weights are presented. Stets Company.

161 Boiler Feed Control—Bulletin 463, 16 pages, describes boiler feed control systems at Westover, Greenidge and Jennison Stations of N.Y. State Electric and Gas Corp. Completely illustrated with photos and line drawings. Tables of significant data included. Northern Equipment Co.

162 Water Level Control—"Controlling Water Level on Combustion Engineering Type VU Boiler," is title of Bulletin 455. These four pages present photos and chart reproductions and tell the details of the company's control equipment on this particular type of boiler. Northern Equipment Co.

163 Water Level Control—Bulletin 459, 8 pages, description of water level control installation at Wyman-Gordon Co. Good illustrations show details of installation. Table of significant data given. Northern Equipment Co.

164 Boiler Water Level Control—Bulletin 467 and 465, 8 pages each, describe respectively, control installations at Buzzard Point Plant and West Reading Station. Both give exceptionally detailed reports of the installation complete with tables, photos and drawings. Northern Equipment Co.

PACKING, GASKETS

165 Packing—Bulletin 237; photos and descriptions of use; installation drawings; standard size table; 4 pages. Warren Steam Pump Co., Inc.

FITTINGS

166 Standards for Flanged Fittings, Valves, Flanges—Pressure temperature ratings, tables and charts, rating procedure, flange materials, safety factors, loading, stress formulas; 20 pages. Tube Turns, Inc.

167 Welding Fittings—Allowable working pressures; power, oil, district heating, refrigeration, gas and air piping; 14 tables and directions for use; 18 pages. Tube Turns, Inc.

168 Welding Fittings—Volumetric capacities; 2 pages of formulas for computation of capacities; 6 pages of tables; 12 pages in book. Tube Turns, Inc.

169 Unions—Complete line of malleable iron unions and convenience unions; illustrations, descriptions, size and list prices; descriptions of materials and workmanship; 24 pages. Jefferson Union Co.

PUMPS

170 Horizontal Duplex Piston Pumps—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions, drawing, tables; 4 pages. Warren Steam Pump Co., Inc.

171 Steam Heat Vacuum Pumps—Bulletin 226-1; specifications, drawings, general information, tables of sizes and capacities; 4 pages. Warren Steam Pump Co., Inc.

172 Centrifugal Pumps—Bulletin 302-30, Revised; instructions for installation and

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operation; drawings, tabular material; 12 pages. Warren Steam Pump Co., Inc.

173 **Hydraulic Pressure Pumps**—Bulletin 238; specifications, sectional photos, important features; full page table of capacity, sizes, pipe sizes, pressure; 4 pages. Warren Steam Pump Co., Inc.

174 **Screw Pumps**—Recommended uses; advantages; tables of capacities and sizes, charts of test results; dimensioned drawings; suctions and discharge, packing box sizes, shipping weights tables; specifications; installation and maintenance; theoretical horsepowers; viscosity classifications; 18 pages. Sier-Bath Gear & Pump Co., Inc.

175 **Centrifugal Pumps**—Booklet describes basic action of centrifugal pumps, tells of the science of centrifugal action and the physics of pumping. Performance curves are presented. Descriptions of the company's self-priming centrifugal pumps are given and how they operate is explained. Typical uses of the units are pointed out and installation and operation explained; 20 pages. Marlow Pumps.

176 **Centrifugal Pumps**—Bulletin 240, 6-page folder describing single stage, double suction, Type DBL centrifugal pump. Features of the pump resulting from its construction and engineering; a sectional view which is used to point out other advantages of the unit. Tables of metal specifications and capacity ratings in gallons are also given. Warren Steam Pump Co., Inc.

177 **Multi-Stage Pumps**—Bulletin 241 describes 4 and 6 stage Type TM pumps. Cross-sectional illustrations and tables of specifications are given. Dimensioned drawings and tables of dimensions accompany copy describing unit's construction and advantages. Warren Steam Pump Co., Inc.

178 **Close-Coupled Pumps** — Close-coupled pumps, called Compac-units, are described in Bulletin 242. This eight-page bulletin presents clear and understandable cross-sectional photos of the units and uses these to point out construction and operation features. A full-page "Composite Rating Table" presents rating information at various heads for 9 different models of pumps. Warren Steam Pump Co., Inc.

179 **Compressors, Vacuum Pumps**—Bulletin C-5; 16 pages. Describes complete details of construction including illustrative material such as photographs of parts of the units and drawings of detailed structural parts. Tables present size and capacity information. Chart of typical characteristics is given. Fuller Co.

MISCELLANEOUS

180 **Floor Resurfacing**—This recently-published folder describes the methods of use of the company's heavy-duty resurfacer for use on floors, traffic aisles and loading platforms. It contains a concise, clear description of the properties, methods of application and advantages of the resurfacer and is of interest to everyone who has problems in the maintenance and repair of concrete floors. Stonhard Company.

181 **Electric Tools**—Bulletin 464; covers complete line of portable electric tools for construction and briefly describes such tools as electric hammers, drills, chisels, vibrating tools, accessories, screw drivers, etc. Prices are given. Syntron Co.

182 **Refractory Concrete**—"Lumnite for Refractory Concrete"; basic information on materials and methods used in making refractory concrete. Illustrations show application of concrete in construction of furnaces, coke ovens, etc. Another section covers concrete use in foundations, floors and structures subject to high heat; 24 pages. Lumnite Division, Universal Atlas Cement Co.

183 **Gas Purger for Refrigeration System**—Bulletin 160; tells how to cut power costs and raise condenser capacity by proper purging of non-condensible gases. Tables of ammonia properties, advantages and complete illustrated material. Typical installations are pictured. Two pages with diagrams tell how purger operates; 8 pages. Armstrong Machine Works.

184 **Grinding Wheels**—Grinding wheels of various abrasives are illustrated and list prices presented; tables of sizes in inches are accompanied by photographs and line drawings of these various wheels. Grinding wheel dressers with list prices are shown; 32 pages. Norton Co.

185 **Weldments**—Bulletin SP106, tells about the services of this company's weldry and the weldments turned out therein. The products of this weldry are shown and the text points out how flexible the method is by showing that it makes no difference if the finished product is constructed of light sheet or heavy metal . . . the resulting product can be made to exacting specifications. Graver Tank & Mfg. Co., Inc

186 **Drop Forged Flanges** — Manufacturing processes; physical characteristics; full-page tables of illustrations, dimensions, weights and prices. Space provided for future insertions. Phoenix Mfg. Co.

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NEW ENGINEERING BOOKS

(*Continued from page 162*)

Front, by George H. Houston; Financing New Industry on the International Front, by James Drumm; and Discussion by Mexican Guests. Industrial research as a profession is young in years, but co-operative conferences such as this are bound to have beneficial results on the economy of the nations participating in such conferences.

The Federal Labor Laws, compiled and edited by the Staff of Executive's Labor Letter, Copyright 1947, size 6 by 9 inches, loose leaf binder, published by National Foremen's Institute, Inc., Deep River, Conn., price $2.50.

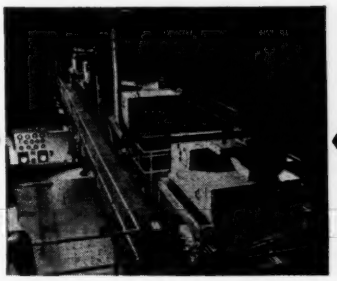
This manual for supervisors on the Federal Labor Laws is designed to give the needed help and present information about Federal Labor Laws which every foreman should know. It offers the basic knowledge necessary to keep the company's slate clean and to avoid tangles with inspectors and the courts. The new and compact 100-page Second Edition of the manual explains the most important aspects of the Wagner Act, the Wage and Hour Law, the Walsh-Healey Public Contracts Act, Unemployment Compensation and Old Age and Survivors Insurance, the Employment Service, the GI Bill of Rights, Veterans Reemployment and Seniority Rights, The Fair Employment Practices Committee, the Railway Labor Act, the Railroad Retirement and Railroad Unemployment Compensation Acts. Also included are all Congressional amendments to date, together with revisions based on new agency regulations or caused by major court rulings. The railroad laws, which also apply to airlines and express companies, are an important new feature of the book. The manual is prepared to be of aid to men who have charge of departments and direct the work of employees, and should be of considerable assistance in not only avoiding trouble but in keeping operating costs down.

The Engineer at Law in Two Volumes, by Conde B. McCullough and John R. McCullough, Copyright 1946, size 6 by 9 inches, Volume I—447 pages, Volume II—442 pages, hard cloth binding, published by the Iowa State College Press, Ames, Iowa, price $3.00 per volume, $6.00 for both volumes.

The Engineer at Law, which is published in two volumes, is a Resumé of Modern Engineering Jurisprudence, and has been prepared to bring to the engineer a better basic understanding of and a more profound respect for the law; to acquaint the engineer with those basic necessities which lie behind the technicalities of legal procedure; to discuss briefly the basic principles involved in those certain branches of law which control engineering operations and activities, to the end that the engineer may have a more intelligent appreciation of the problems which confront the attorney; to indicate to the engineer the necessity for so planning and prosecuting his work as to satisfy the technical requirements of the law as well as its equitable demands; to aid the engineer in giving more intelligent service in court or in working up the engineering data necessary for court presentation; and to outline some of the intricacies of legal procedure to convince the engineer of the folly and futility of attemption to do his own legal work.

The above objectives given in the introductory chapter are followed by articles on the Origin and Evolution of American Law; Justice and the Law; Engineers, Engineering and the Law; the Engineer's Contact with Particular Phases of the Law. Other chapter headings are: Courts, Court Procedures, and Systems of Jurisprudence; The Equity Side of the Law; Contracts and Contractual Relationships; Engineering Specifications; Laws Governing Real Property; Torts Incident to Engineering Operations; continuing in Volume Two with: Employment Relations in Engineering; The Engineer in Trial Work as Technical Witness, Councellor, or Assistant; Patents, Copyrights, and Trade Marks; Corporations, Public Utilities, and Carriers; Administrative Law; The Law of Sales; Nego-

Keep your boilers at their best
Keep them constantly on test



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The password to big operating economies and top efficiencies from boiler batteries is "coal-control"—through the use of Richardson Automatic Coal Scales. Safeguarded by continuous readings of coal consumed by each boiler as provided by these scales, you can determine and compare amounts of steam generated per pound of coal. You can spot losses at their very source . . . *quickly.*

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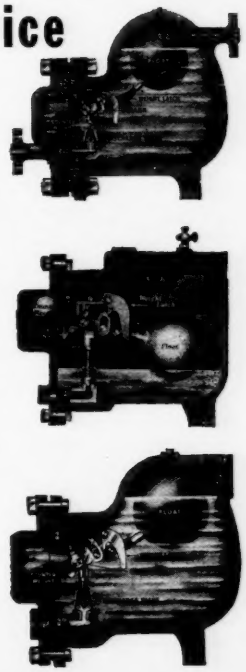
STOP LIVE STEAM LOSS
in Superheat Service
WITH
Nicholson LEAK-PROOFED Weight-Operated Traps



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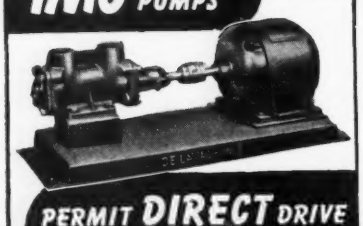

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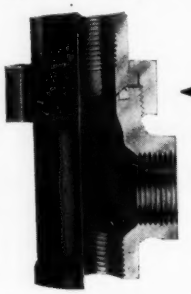

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tiable Instruments; and Pleading and Procedure.

This set of engineering law books, in addition to being intensely interesting reading for the man with an engineering type of mind, is immediately useful to the professional engineer and can be used to advantage as a textbook in engineering law.

Specifications and Tests for Electrodeposited Metallic Coatings, prepared by Technical Committees representing the American Society for Testing Materials and American Electroplaters' Society, Copyright 1946, size 6 by 9 inches, 52 pages, paper cover, price $1.25, published by The American Society for Testing Materials, Headquarters, 1916 Race Street, Philadelphia 3, Penn.

In the presentation of these standards, the sponsoring societies state that this publication has been compiled to collect all of the ASTM specifications and methods of tests pertaining to electrodeposited metallic coatings on metals so as to have all of them together in a convenient form for the use of the industry. The specifications and methods of test are given in their existing form at the time of publication of this compilation but some of them are tentative with the possibility that they may be changed before adoption as standard and any of them may be revised from time to time as required. The publication contains specifications for electrodeposited coatings as follows: Zinc on Steel; Cadmium on Steel; Nickel and Chromium on Steel; Nickel and Chromium on Copper and Copper-Base Alloys; Lead on Steel and Chromate Finishes on Electrodeposited Zinc, Hot-Dipper Galvanized, and Zinc Die-Cast Surfaces. In addition to these specifications the publication describes methods of test for local thickness of electrodeposited coatings and the testing of salt spray. Also contained in the publication are recommended practices for chromium plating on steel for engineering use, and low-carbon steel for electroplating. The publication should be of extreme value to all electroplaters, particularly those whose work must hold up to specific requirements.

REFRIGERATION MANUFACTURERS AND THE HEAT PUMP

SHOULD the widely-publicized "heat pump" prove practical in operation and popular in demand, the mechanical refrigeration industry would be in a position to supply at least 90 per cent of the basic component parts without engineering delays or production tool-ups.

This was pointed out recently by E. M. Flannery, newly-elected president of the Refrigeration Equipment Manufacturers Association.

Mr. Flannery explained that the "heat pump" actually is reverse cycle mechanical refrigeration and thus utilizes the same parts and machinery as does the ordinary refrigeration system, including compressors, condensers, chemicals, expansion valves, thermostatic controls, motors, switches, tubing, coils, receivers, evaporators and others, all of which already are in volume production in many plants throughout the country.

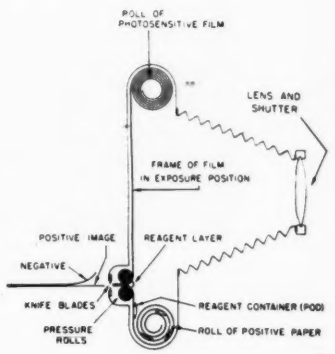
The new REMA president declared, however, that the refrigeration industry as a whole "has no present plans for going into the heating business" but that it is continuing its cooperation with heating engineers, as is typical in the case of year-round air conditioning whether both cooling and heating are incorporated in the same systems. At the same time, some producers manufacture both refrigerating and heating equipment, he said.

ENGINEERS' PREVIEW

BY THIS TIME everybody is aware of the new photographic process developed by Edwin H. Land, president and director of research of Polaroid Corp.; it has been described in some detail in the newspapers. In a camera containing a special film, printing paper and developing chemicals, it is necessary only to expose the negative, then pull the negative and printing paper through suitable devices that break a capsule or pad of chemical between them, the chemical spreading and thus developing both negative and print at the same time. At the end of less than a minute, the two can be separated, the finished picture is observable and if it is not satisfactory another exposure can be made at once.

But just how is all this done? You know, of course, that when light enters through the lens of a camera and falls on the film, it delivers some of its energy to the silver-bromide crystals with which the film is coated. If a crystal receives enough energy, a few atoms of pure metallic silver form within it. With these atoms already formed, the whole crystal is primed to turn quickly and completely into black metallic silver when it is later treated by the developing solution.

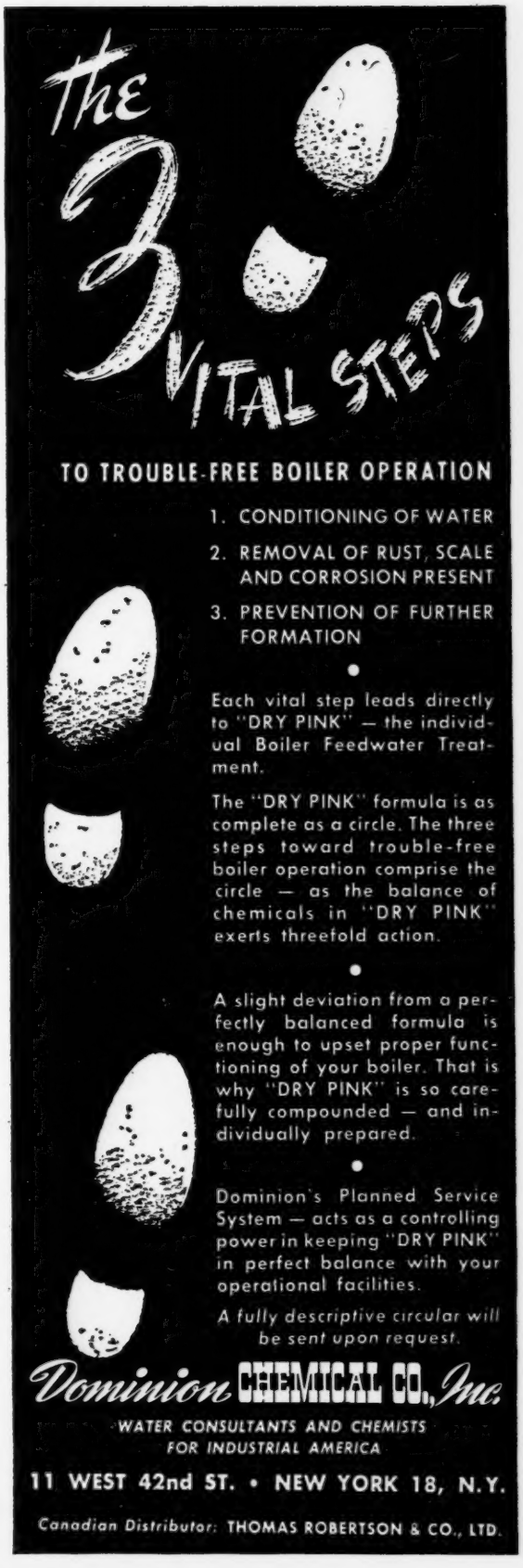
All modern films depend on this formation of a "latent image" by the light that enters the camera. In it, bright objects are represented by film areas in which many crystals are primed or exposed and ready for quick conversion into pure silver. Dark objects are represented by areas in which most of the crystals are not exposed and will resist development.



In the usual photographic process, only the exposed crystals in the latent image are used. A developing agent, usually hydroquinone, turns them into the silver that forms the visible image. Then hypo (sodium thiosulfate), a good solvent for silver bromide, dissolves the unexposed and undeveloped crystals and washes them away. The exposed crystals form a negative image, darkest where the scene is lightest, hence the whole process has to be repeated to get a useful positive print.

The Land soluble silver complex process, employing standard photographic films, makes the positive print out of the silver that is ordinarily discarded. The few drops of viscous chemical released within the paper and film sandwich when the knob sets the rollers in operation, contains both developer and

(Continued on page 183)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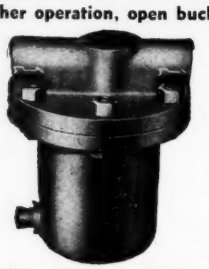
Double Rating on continuous discharge
No Waste of Steam
Stainless Steel valves, seats and buckets
Easy to Install
Water Seal entirely within trap



#52 AIRXPEL STEAM TRAP for WSP to 250 psi. 1" screwed connections. Other sizes to 700 psi.

You will find complete details in Circular 259-A. Send for a copy today.

Inside the "Cub"

This view shows the inside water seal that prevents waste of steam. It shows also straight thru pipe connections and accessibility of valve and seats.

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B & W FILM ON MARINE BOILERS

A MOTION picture showing fabrication, assembly and functioning of modern marine boilers has been produced by The Babcock & Wilcox Co. It is designed to acquaint engineers and students with the fabrication and assembly of such boilers, and to show how the boilers operate.

The 16mm sound film, "Steam Power for American Sea Power," has a running time of 30 minutes. It is available to all engineering societies and colleges, and to interested companies.

After a short introduction stressing the importance of sea power and depicting the various designs of boilers manufactured by The Babcock & Wilcox Company for marine service, the scene shifts to Barberton, Ohio, where important steps in the fabrication of marine boilers are shown. The sequence begins as a flat steel plate is machined and formed to shape. The camera shows machining of welding grooves, welding of drum seams and pressing of the drum head. It follows the drum as it is X-rayed, stress relieved and the tube holes drilled.

Inquiries concerning this 16mm sound film should be addressed to: Marine Department, The Babcock & Wilcox Co., 85 Liberty Street, New York 6, N.Y.

"Boiler Repairs Reduced 75%" writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

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over 1500
types and sizes in
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VALVES
for safe protection
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installation

In addition to more than 1500 standard types and sizes of manual or automatic steam and water service valves—GOLDEN-ANDERSON engineers design and build special valves to meet most any difficult high or low pressure service.

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Standard shapes to 10 in., also special shapes to order
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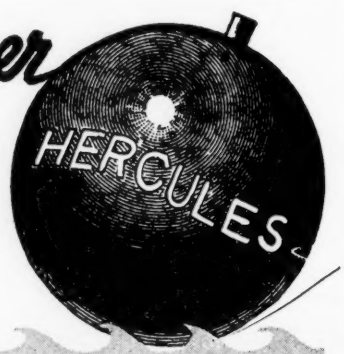
Tell us about your water float problems



HERCULES FLOAT WORKS
200 Franklin Street, Springfield, Mass.

FOR TANKS AND HEATERS — SPECIFY HERCULES FLOATS

ENGINEERS' PREVIEW

(*Continued from page 181*)

hypo. Both chemicals go to work promptly. The hydroquinone turns the exposed crystals into silver on the film, the hypo takes into solution the silver of the unexposed crystals.

The exposed crystals of the negative image are turned into silver, and kept within the film, out of circulation. The silver from the unexposed crystals, however, is free to move. The hypo takes it into solution within the thin layer of reagent between paper and film. There, the hydroquinone and other chemicals develop it and deposit it to form the positive image. In effect, the developer performs the double service of holding silver of the exposed grains out of circulation in the negative, and forming the positive image from the silver carried into solution by the hypo. The hypo performs a shuttle service, carrying the silver in the unexposed crystals from the film to the paper, and returning for more when its load of silver complex has been taken from it by the other chemicals.

In addition to the plastic, the developer and the hypo, a number of other ingredients are used in the viscous mixture contained in the pod, or on the surface of the receiving paper. These ingredients control the size of the silver particle, which determines the color of the print; the rates at which the various reactions occur; prevent discoloration of the print; and make the process work over a wide temperature range. It is interesting to note that in the extensive literature that exists on the science of photography, the inventor declares, there are no references to an instantaneous system of photography, even as an ideal. He points out, however, that in 1945, Dr. Vannevar Bush wrote in an *Atlantic Monthly* article that "often it would be advantageous to be able to snap the camera and to look at the picture immediately."

★ ★ ★

SKELETON-TYPE lightweight handlift truck for short move jobs to 1 ton, has 70-in. overall length, 11¾ by 43-in. platform area, on four metal wheels; is suggested for skid-loads, boxes, crates, trays of material, miscellaneous items.

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NEW SMALL ENGINES for farms will use gasoline into which farmer has put 10 per cent (or slightly more) alcohol from bottom of his silo. To permit this, engines have closer tolerances than airplane power plants. Alcohol content claimed to give cooler running, high acceleration, lower operating cost. Blended-fuel plan recommended for supplying power to cream separators, milking machines, churns, farm lighting, hay cutting, wood sawing, other normal farm work.

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IN A COMPLETE new line of d-c and a-c meters of 2 and 2½ in. sizes, available in round or rectangular cases, all d-c's are polarized vane and solenoid type, all a-c's are double vane repulsion type.

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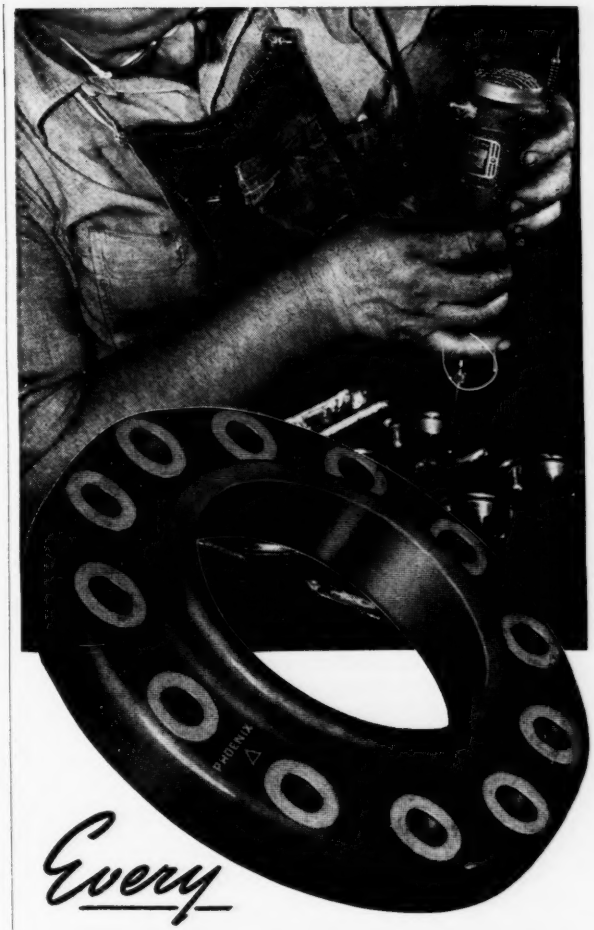
FOR INDUSTRIAL use, new phototube relay has plug connections for quick removal and replacement with an identical unit, 1/20 second speed of operation with ¼ second release. Output circuit relay handles 5 amp non-inductive load.



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Our Oil Burners are extensively used as supplementary firing equipment in existing stoker fired boilers

When coal deliveries fail or stokers are inadequate to meet peak steam demands, the installation of a supplementary fuel system assures the desired capacity. In some cases, up to 75% of the peak load has been easily carried on the supplementary fuel (depending in proportion on geographic factors and relative costs of the several fuels) without clogging of boiler passes or objectionable smoke and cinders. Such installations become dual fuel systems . . . inexpensive insurance against plant shut-down. Can your plant afford to be without this insurance?

Types "SA" and "SAR" Oil Burners are ideal for installation as supplementary fuel systems. Type "SA" is adaptable to all forms of industrial heating, power or process furnaces; completely atomizes and thoroughly burns the lowest and cheapest grades of fuel oil, tar, and waste oils; requires only low oil pressure and temperature, and the internal atomizing feature uses steam for atomization. Type "SAR" (where steam or gas is available for atomization) safely and efficiently burns residuums obtained from process.

We have been *specialists* in the burning of liquid and gaseous fuels for 35 years. Your inquiries, accompanied by full plant data are invited . . . write now for Bulletin #21.

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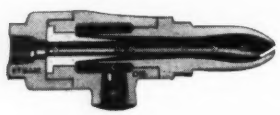

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POWER PLANT *Construction News*

Ala., Falkville—Village Council plans installation of a natural gas-distribution system, including metal house, control station, pressure pipe line for connection with supply source. Cost estimated about $425,000. J. W. Goodwin Engineering Co., 726 South 29th St., Birmingham, Ala., is consulting engineer.

Ala., Pleasant Grove—Village Council has plans under way for installation of a municipal gas system, with control station, meter house, main pressure pipe line for connection with supply source and other operating facilities. Cost reported about $400,000. J. W. Goodwin Engineering Co., 726 South 29th St., Birmingham, Ala., is consulting engineer.

Colo., Meeker—White River Electric Association, Inc., Meeker, plans expansion in power plant, with installation of equipment for increased capacity. Entire project reported to cost close to $240,000, including line construction.

Fla., Miami—Citizen's Ice Co., Pan-American Bank Bldg., has approved plans for new one-story ice-manufacturing plant on local site at 3525 N.W. North River Dr., and will begin work soon. Cost reported over $50,000, with equipment. L. B. Taylor, duPont Bldg., Miami, is engineer.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., is considering construction of new one-story power substation, about 46 x 75 ft., at 5043-49 West Madison St. No estimate of cost announced.

Ill., Chicago—W. H. Salisbury & Co., 401 North Morgan St., mechanical rubber goods, plans installation of electric power equipment in new one-story addition, 100 x 100 ft., reported to cost close to $100,000, with machinery. Engineering Systems, Inc., 221 North LaSalle St., Chicago, is engineer.

Iowa, Dubuque—Farley & Loetscher Mfg. Co., Dubuque, millwork products, has plans for new power plant at mill, reported to cost over $100,000, with equipment. Contract has been placed for structural steel framing and work will begin soon. Laramore & Douglass, 327 South LaSalle St., Chicago, Ill., are consulting engineers.

Iowa, Sioux Center—Town Council has tentative plans for new municipal power station and electrical distribution system. Proposed to use Diesel engine-generator units and accessories. Cost reported about $175,000. Buell & Winter Engineering Co., Insurance Exchange Bldg., Sioux City, Iowa, is consulting engineer.

Ky., Louisville—Cochran Foil Co., 1403 South 13th St., tin and other metal foils, plans installation of electric power equipment in proposed one-story addition to plant, reported to cost about $200,000. Work is expected to begin in near future.

La., Bastrop—Single Service Containers, Inc., 205 East 42nd St., New York, N.Y., plans new local plant for manufacture of paper container blanks, comprising large one and multi-story building and auxiliary structures. Electric power equipment will be installed. A power substation is planned. Entire project is estimated to cost close to $5,000,000, with machinery. Site has been selected.

La., De Quincy—City Council has engaged Barnard & Burk, Triad Bldg., Baton Rouge, La., consulting engineers, to prepare plans for a proposed new municipal power plant. It is understood that Diesel engine-generator units and accessories will be used. Estimates of cost will be made soon. An electrical distribution system is included in program.

Mich., Comstock—Consumers Power Co., Jackson, Mich., has completed plans for proposed addition to Bryce E. Morrow generating station at Comstock, and will begin work soon. Contract has been let for steel frame superstructure. Equipment will be installed for increased capacity. No estimate of cost announced.

Mich., Jackson—Goodyear Tire & Rubber Co., plans addition to power plant at local factory, estimated to cost close to $150,000, with equipment. Work is scheduled to begin soon. Main offices are at 1144 East Market St., Akron, Ohio.

Mich., Portland—Tri-County Electric Cooperative, Portland, plans expansion and improvements in generating station, with installation of new 1000-kw. Diesel engine-generator, and auxiliary equipment. Cost reported over $275,000. Work is scheduled to be carried out soon.

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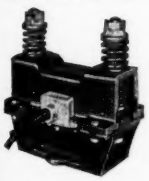
Hammer and Sledge Marks on Your Bins, Hoppers and Chutes?

SYNTRON
"Pulsating Magnet"

ELECTRIC VIBRATORS



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Eliminate Pounding and Sledging

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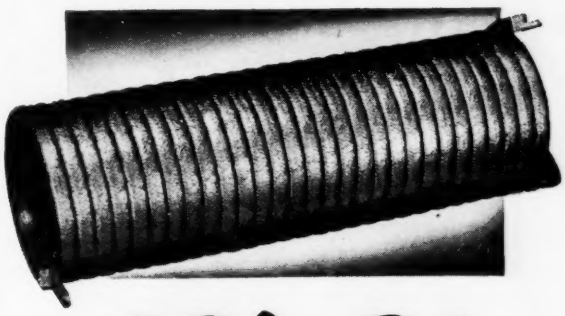

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Minn., Kettle River—Carlton County Cooperative Power Assn., Kettle River, is completing plans for three new power substations and will carry out work soon. No estimate of cost announced. United Engineering Service, Inc., Kasota Bldg., Minneapolis, Minn., is consulting engineer.

Minn., Lakefield—Light & Water Dept., plans extensions and improvements in municipal oil-engine-operated generating station, with installation of additional equipment. Cost estimated about $60,000. Proposed to carry out work during summer. Ralph D. Thomas & Associates, Metropolitan Life Bldg., Minneapolis, Minn., are consulting engineers.

Minn., Minneapolis—Board of Public Welfare, City Hall, has preliminary plans under way for new boiler house for central-heating service at city hospital and court house. Cost estimated close to $800,000, with boilers, pumps and auxiliary equipment, including distribution lines. Long & Thorshov, Inc. are architects, and Ralph D. Thomas & Associates, engineers, both Metropolitan Life Bldg., Minneapolis.

Miss., Jackson—Mississippi Power & Light Co., Jackson, will proceed with superstructure for proposed new generating station on site near city, to be equipped for a capacity of 30,000-kw. It will be known as Rex Brown power station and is expected to be completed late next year. Cost reported in excess of of $4,500,000. Ebasco Services, Inc., 2 Rector St., New York, N.Y., is consulting engineer.

N.J., Harrison—Public Service Electric & Gas Co., Newark, N.J., plans extensions and improvements in artificial gas plant at Harrison, including construction of new liquid purification plant, and pumping station. Cost about $400,000.

N.J., Trenton—Sloan-Blabon Corp., Bear Swamp Rd., linoleum and other hard-surfaced floor coverings, plans installation of electric power equipment in large addition to plant. Cost reported over $1,000,000. Walter Kidde Constructors, Inc., 140 Cedar St., New York, N.Y., is engineer and will supervise erection.

N.Y., Syracuse—Church & Dwight Co., Inc., 1416 Willis Ave., chemical specialties, plans installation of electric power equipment in new one-story addition, 95 x 150 ft., reported to cost over $140,000. Austin Co., 16112 Euclid Ave., Cleveland, Ohio, is engineer for building.

Ore., Huntington—Idaho Power Co., Boise, Idaho, plans new hydroelectric generating station on Snake River, vicinity of Huntington. Plant will have a capacity of about 140,000-kw. It is understood that work will begin in fall. No estimate of cost announced. Application for permission has been made to Federal Power Commission.

Ore., Tillamook—Tillamook County Creamery Association, Tillamook, plans boiler plant, 30 x 40 ft., at new milk-processing factory. A cold storage plant also will be built. Electric power equipment will be installed in production division. Entire project is reported to cost over $750,000. Alexander Stoyanov, 8135 N.E. Union Ave., Portland, Ore., is engineer.

Pa., Clarion—State Dept. of Education, Harrisburg, has preliminary plans under way for extensions and improvements in power house at State Teachers' College, Clarion, with installation of equipment for increased capacity. Work will be carried out in connection with new buildings and other betterments at institution, entire project to cost about $350,000.

Pa., Shippensburg—State Dept. of Education, Harrisburg, Pa., plans extensions and improvements in boiler house at State Teachers' College, Shippensburg, used for central-heating service, with installation of equipment for replacements and expansion. Program will be carried out in connection with other improvements at institution, entire project to cost close to $400,000.

S.D., Chamberlain—Central Electric & Telephone Co., Sioux Falls, S.D., is considering extensions and improvements in Diesel-electric generating station at Chamberlain, including new addition, 40 x 70 ft., and installation of equipment for increased rating. Cost reported close to $50,000. John A. Schoening & Associates, National Bank of South Dakota Bldg., Sioux Falls, S.D., are architects.

Texas, Garland—Municipal Electric Dept., 501 Ave. A, plans expansion and improvements in municipal oil engine-operated generating station, with installation of additional equipment. Capacity will be increased. Cost estimated about $170,000. Bond issue in that amount has been authorized.

Wis., Racine—Bd. of Directors, St. Luke's Hospital, 1301 College Ave., Ruth A. Brown, superintendent, has plans for new boiler house at institution for central-heating system. No estimate of cost announced. Schmidt, Garden & Erikson, 104 South Michigan Ave., Chicago, Ill., are architects.

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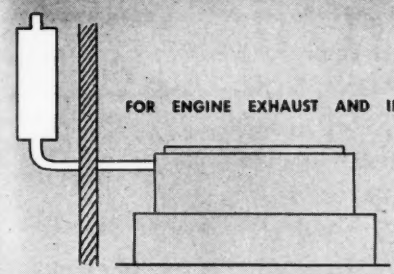

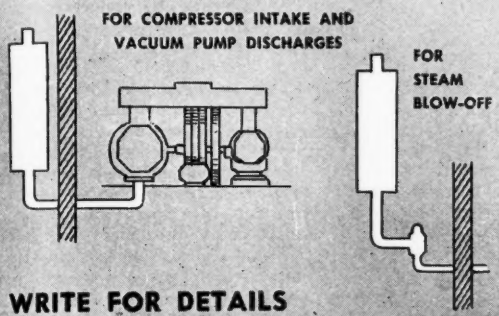

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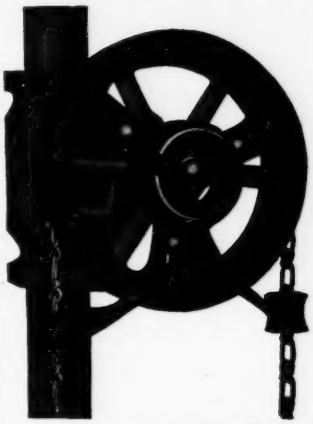

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By E. H. JERNBERG,

Mechanical Design Engineer, Electric Machinery Mfg. Co.

VULNERABILITY of electric motors used in industry is mechanical, chemical, thermal, or electrical in nature. In the past, most motor builders centered attention on improving performance characteristics under normal operating conditions, with less attention being given to the problem of protecting the motor against damage from external causes. Temperature rise and insulation breakdown received attention early and resulted in the development of superior insulating materials. Recently, industry's demands for better packaging of heavy-duty power has resulted in a near-standardization of external protective construction as a minimum requirement for many applications.

Except for extremely dirty, hazardous or outdoor locations, the drip-proof motor or the splash-proof motor will usually satisfy external protection requirements, and this construction is now a recommended selection to protect the motor where it is subject to falling dirt, liquids or splashing. The additional cost of drip or splash-proof protection is well justified by the reduced maintenance it affords in guarding the internal motor parts against external damage, and by greater reliability to offset the ever-increasing cost of down-time.

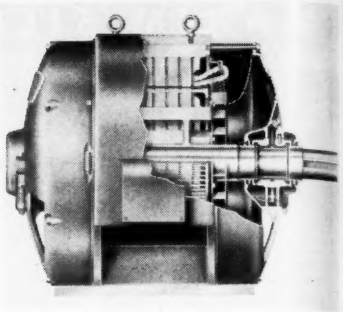

Fig. 1. Drip-proof squirrel-cage induction motor with sleeve bearings

A splash-proof synchronous motor which by its appearance reveals that design was undertaken with the objective of producing a protective type motor; appearance is thus enhanced and cleaning is easier in comparison with results obtained by the former practice of "modifying" a standard open motor with shields and baffles.

Frame fabrication by welding permits extra strength with reduced weight, and packs more horsepower into a given volume.

Internally, improved design and methods favorably affect the ratio of size and weight to horsepower. The squirrel-cage winding in Fig. 1 is connected at the ends by means of phos-

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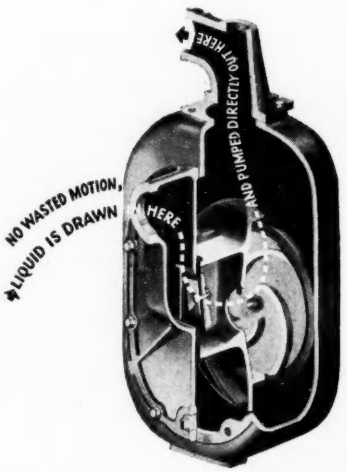

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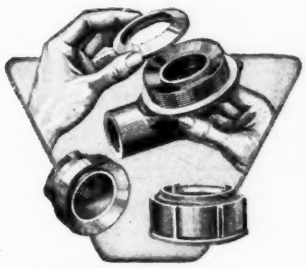

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Fig. 4-F

Fig. 18

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Fig. 12

Round • Clear and Red Line

Leakless Cocks

Fig. 13

Fig. 22

Fig. 23

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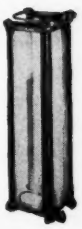

Fig. 9

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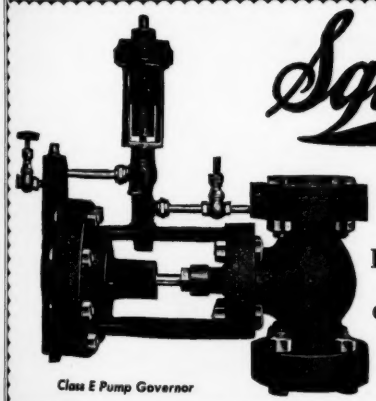

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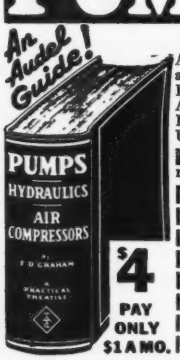

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